# Essays on Relative Performance Evaluation

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# Introduction

Relative performance evaluation (RPE) is evaluation of an agent's performance relative to a peer performance. The agency theory suggests that basing an agent's compensation contract on RPE would insulate him from common shocks unrelated to his performance. Hence, the presence of RPE removes unnecessary risk from the contract and offers a more informative tool for the agent's performance evaluation. Due to its risk-sharing benefits RPE is typically used in executive compensation or in decisions regrading the executive turnover.

In order to start economic analysis of relative performance evaluation the stage needs to be set by examining the practice of corporate governance as a "product of decisions in many dimensions: board structure, security design, incentive schemes and the like" (Hermalin 2013, p.746). In particular, analysis of corporate governance is to set out the basic theoretical structure that lies behind the premise of relative performance evaluation – the agency theory.[1] The extensive academic literature has generated numerous definitions of corporate governance (Shleifer and Vishny 1997, Tirole 2001, Hart 1995, Sun et al. 2011, Hermalin 2013). These definitions could yet be portioned in two main branches. The first one takes maximizing the shareholder value as the main goal of the governance system. For example, according to Shleifer and Vishny (1997, p.737) "corporate governance deals with the ways in which suppliers of finance to corporations assure themselves of getting a return on their investment". Hermalin (2013) and Lazonick and O'Sullivan (2000) take a similar stand.[2] The second branch takes a broader view and considers corporate governance system as the whole set of regulatory, market, stakeholder and shareholder (internal) governance. In this view, shareholders are not the only party whose interests are to be maximized. The good corporate governance system is to act in the interests of several stakeholder groups, such as banks, suppliers, customers, government, etc. (Tirole

[1]The evolving literature on relative performance evaluation has been truly interdisciplinary. It spans organizational and personnel economics, labor economics, accounting, corporate finance, organizational behavior. However, in the context of relative performance evaluation the agency theory represents a link between these disciplines. In economic theory, the agency theory is part of the research stream denoted as contracting theory. The agency theory can be divided into two branches: 1. The adverse selection stream – This stream assumes that the agent has private information about his "type". This information is not known to the principal before the contract is written 2. The moral hazard stream – This branch contends that the agent realizes his "type" after the contract has been written (Salanie 2005). For more details on the contracting theory see Salanie (2005).

[2]Hermalin (2013, p.735) is focused on the narrow definition of the corporate governance system as accounting for all the parties affected by the corporate governance would make the analysis of corporate governance overcomplicated and complex.

2001, Hart 1995, John and Senbet 1998, Sun et al. 2011). Both branches of corporate governance share one common element which merits our attention. That is, the fact that corporate governance should create a framework where managers serve the interests of shareholders or stakeholders, and maximize their utility. The central role of corporate governance system is to mitigate any potential conflict of interest, in particular the one that might arise between managers and shareholders, and to ensure that the firm's assets are used efficiently and in accordance with the shareholders' interests.

An attempt to define corporate governance reveals two basic conceptual features that might lead to the failure of a governance system to fulfil its main role (Hart 1995). First, there is a conflict of interest that arises due to "separation of ownership and control" (Jensen and Meckling 1976). The first to notice this issue was Adam Smith in 1776. In his eminent work "Wealth of Nations" he notes: "The directors of such companies, however, being the managers rather of other people's money than of their own, it cannot well be expected that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own. Like the stewards of a rich man, they are apt to consider attention to small matters as not for their master's honor, and very easily give themselves a dispensation from having it. Negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such a company" (Smith 1776, p.408). In other words, the interests of the capital owners, shareholders, and those who are controlling the company, managers, are divergent. Shareholders delegate tasks to managers expecting that they will maximize their utility. Yet, managers are not necessarily incentivized to optimally conduct this task, as they are not the owners of the firm. They are self-interested and want to maximize their own utility first (Hart 1995). In other words, they tend to take actions that minimize the effort invested in certain activity.[3] Second, in order to undergo this problem, shareholders would have to write a contract which should specify the "parties' obligations in all states of the world to the fullest possible extent" (Hart 1995, p.679). This, however, is not attainable. Even if it was, it would incur enormous contracting costs to the shareholders. Hence, shareholders have to accept this imperfection and write contracts that are deemed to be "incomplete". This setup leaves enough space for manipulation from parties signing the contract. This makes the study of agency relationship critical (Hart 1995, Hermalin 2013).

In order to avoid undesired manipulation by managers, shareholders need to impose certain mechanisms. The primary purpose of such mechanisms is to create a framework which would tackle with the timing preferences of shareholders and management. That is, managers are often impatient, and therefore focused on the short-term results. Shareholders, on the other hand, are concerned about the long-term value of the company and would like their management to be as well. An example of a mechanism that can impose this is executive incentive scheme or executive compensation. Again, imposing such mechanism comes at a certain cost for the shareholders. These costs are denoted as "agency costs"

[3]This issue firstly recognized by Smith (1776) was later on formalized as an "agency problem" comprised within the economic "theory of the firm" in the study by Jensen and Meckling (1976). However, the study by Berle and Means (1932) is the earliest modern work on this problem.

by Jensen and Meckling (1976).[4] Given that the agent in a firm is often self-interested, his behavior might not always produce a Pareto-efficient outcome for the firm which creates an incentive problem (Gibbons and Roberts 2013, p.56).[5] However, this behavior might be altered by the means of an appropriate contract. The agency theory suggests that compensation contracts represent an important tool for structuring agent's (executive) incentives by tying the compensation to the available information about the agent's effort. As such, executive compensation contract should attract and retain personnel with skills necessary to run the company and motivate them to promote the long-term value of the firm.

The agency theory typically assumes that the agent is risk-averse and that information about his effort is imperfect – it contains noise. Hence, when the agent's contract is based on such information, which is most commonly proxied by firm performance, the agent faces unnecessary risk. Tying an agent's contract more strongly to such information increases the risk he bears instead of making his incentives stronger. Hence, such contract contains a trade-off between appropriately motivating the agent and the agent's risk-sharing (Gibbons and Roberts 2013). Put it other way, the manager bears a significant amount of risk and is not incentivized to invest the level of effort optimal for the shareholders. This induces costs for them. When information about the agent's effort is not optimal the agency theory suggests the "Informativeness Principle" to tackle with this problem (Holmstrom 1979). This principle has been known as Relative Performance Evaluation and it reduces the risk borne by the agent and therefore "weakens" the trade-off between inducing the desired behavior of agent and the agent's risk-bearing. Relative performance evaluation suggests that the performance of an agent should be measured relative to other similar agents in order to remove common risk that are out of his control. This removes unnecessary risk from the agent's contract and offers a more informative measure of his performance.[6] Hence, relative performance evaluation has important implications for the executive contract design. As noted by Prendergast (1999, p.14) theoretical prediction of RPE allows researchers to investigate whether the agents are evaluated based on how well they perform in comparison to the peers in the similar environment and whether the use of relative performance evaluation increases with the correlation between the agent's and peers agents' performances. In order to examine RPE in executive compensation contracts researchers typically regress executive pay on firm and peer performance variables.[7] The

[4]Jensen and Meckling (1976) denote agency costs as the overall costs of an incomplete contracting. The agency costs include the monitoring costs, the agents' bonding costs and the residual cost. The bonding costs are incurred by the agent and come as a consequence of the agent's pledge to the contract obligations which can limit his activity. Monitoring costs are incurred by shareholders. Finally, residual costs are a result of additional divergences between principal and agent. They occur in addition to the use of monitoring and bonding (Jensen and Meckling 1976, p.308).

[5]In reviewing economic theories on incentives in organizations, Gibbons and Roberts (2013, p.59) note that incentive problems in the principal-agent setting come as a consequence of: 1. the agent's risk characteristics coupled with the noisy information about his effort 2. the manageable information about the agent's effort 3. the fact that restrains on how much an agent can be paid are exogenous.

[6]The Holmstrom's Informativeness Principle is one of the four principles of contract design identified by Migrom and Roberts (1992). The Incentive-Intensity Principle, the Monitoring Intensity Principle and the Equal Compensation Principle represent the three remaining principles.

[7]Alternatively, researchers investigate whether the external shocks are removed from the executive

negative and statistically significant coefficient on peer performance represents an indication of the RPE presence. The academic literature makes a distinction between two types of RPE tests – the weak-form and the strong-form test. The first one investigates if *some* of the exogenous shocks are removed from the compensation contract or a CEO turnover decisions, whereas the latter one examines if *all* the shocks are filtered out. Alternatively, researchers also distinguish between the implicit tests of RPE that infer a peer group performance, and explicit tests which use information disclosed in the proxy statements in order to determine peer performance.

Relative performance evaluation in the context of executive contracts concerns both the board of directors, shareholders but also managers. Evaluating a manager's performance relative to an appropriate performance benchmark increases the quality and informativeness of performance evaluation. As a consequence, the board has a more sophisticated measure of the manager's performance. From the shareholders' perspective a presence of RPE in executive compensation contracts signals that the firm practices a good governance policy, at least with respect to executive pay. As such it represents one aspect of the firm's efforts to be committed to the corporate responsibility practices. The presence of RPE implies that the manager is insulted from negative shocks on the market. That is, he is not punished for the events that are out of his control. This, in the same manner, implies that the manager is not rewarded for simply riding a bull market. Hence, the presence of RPE should limit the manager's opportunity to enjoy excessive pay.[8] From the ethical point of view, the presence of RPE in executive compensation contracts suggests that firms entertaining it are, at least in the context of executive pay, committed to the standards of fairness. Against this backdrop, this dissertation examines relative performance evaluation hypothesis, which suggests that managers should be evaluated relative to their peer performance in order to remove the common risk components from their compensation contract. In particular it investigates the disclosure with regard to relative performance evaluation in the banking industry and peer performance composition used in RPE tests.

Given that the research on RPE is spread across different fields, the main goal of the Chapter 1 is to review empirical literature on RPE and set up a ground for its empirical investigation. Hence, Chapter 1 examines around 50 empirical studies on RPE in the context of executive pay and executive turnover from 1986 to the present day and condense its main findings. It represents a state-of-the art literature review on relative performance evaluation. The literature examining the existence of RPE in executive pay has produced scarce and inconclusive evidence, often not in accord with the predictions of the principal-agent theory. Such evidence is often regraded as puzzle worth investigating by some academics (Murphy 1999, Hall and Liebman 1998, Celentani and Loveira 2006). As a consequence, many streams of literature have evolved in order to come up with an explanation for this puzzle. It appears that many studies ignore strategic interactions between firms and use misspecified peer groups when testing RPE which creates a bias in the RPE tests. In addition, ignoring executive characteristics such as CEO talent, wealth,

turnover decisions. This is thoroughly discussed in the Chapter 1.

[8] I, of course, acknowledge that there are other means of limiting the excessive executive pay in addition to imposing relative performance evaluation in executive pay contracts.

and age or his power over the board of directors might lead to the failure to detect RPE. When a manager determines a firm's strategy and makes investment decisions through choosing the firm's exposure to sector performance, his pay should be positively related to the sector performance. In this case RPE is not optimal. Firm's decisions to explicitly use RPE varies with the firm size, the level of growth options, common risk the firm faces, investment in research & development costs but also with whether the firm belongs to a concentrated industry or not. Moreover, the amount of equity holdings held by the CEO and the number of independent directors play a role in determining the RPE use. Furthermore, the presence of compensation consultants also affects RPE tests. Better accounting regulation seems to induce the accounting-based RPE use due to better accounting information and its comparability across countries. Many conditions that influence RPE tests on the firm-level are more strongly related to the RPE conditions at the compensation plan level. Hence, before making decisions on whether to implement RPE, firms evaluate both its benefits and costs. Chapter 1 also examines whether boards use relative performance measures when deciding whether to retain managers in the firm or not. At the first glance, the results of the studies seem to be more conclusive than the studies examining the same hypothesis in executive pay. However, a closer look suggests that academic literature has mostly relied on the weak-version RPE tests. When the strong-form tests are employed the evidence with respect to RPE are weaker. Moreover, some piece of evidence indicates that previous studies have been too conservative when defining a CEO turnover, which might create bias in the RPE tests. Taken together, Chapter 1 offers an overview of important factors which affect the inferences drawn on relative performance evaluation in executive pay and turnover decisions. These factors should be taken into consideration in the future RPE empirical specifications.

Chapter 2 investigates the existence of RPE in international banking and pays particular attention to banks that seem to claim its use in executive pay. It also deals with the potential issue of RPE being a corporate cheap talk. The global banking industry is particularly suitable for testing RPE due to the fact that banks operate in an internationally integrated environment with intense competition and are strongly exposed to common risks. Moreover, the recent financial crisis has raised concerns about the compensation policy in the banking industry which makes the investigation of RPE in the banking industry particularly compelling. In order to test RPE we collect data on 42 large, non-U.S banks. Hence, we utilize the industry and industry-size method developed by Albuquerque (2009) in order to construct corresponding peers. We first test RPE use on the full sample of banks. We find negative and insignificant parameter estimates on industry measures of peer performance. This lends no support on the use of RPE in our sample. When we perform tests of RPE on more sophisticated industry-size peers, we find weak evidence consistent with RPE. We then disentangle between RPE disclosing and non-disclosing banks and repeat the RPE tests. When we restrict our attention to the subsample of RPE-disclosing banks, we report strong and more conclusive evidence with respect to RPE. Strong-form RPE tests dovetails these results. This implies that disclosure statements with respect to RPE do have some merit. To gain more insight, we investigate the main drivers of RPE in our novel sample of banks. A logistic regression indicates that firm size and growth options play a major role in determining the likelihood of RPE

usage. The results imply that the greater a bank is, the higher the probability that it will use RPE in its compensation contracts. This comes as no surprise as large banks after the financial crisis have been under significant pressure to be more committed to a better compensation policy and, thereafter to the RPE use. On the other hand, the probability of RPE use in compensation contracts is decreasing with the magnitude of growth options. This evidence dovetails previous academic literature – high growth option firms might find it more difficult to identify an appropriate peer group. As a consequence, these firms are less prone to the RPE compensation practices.

Chapter 3 develops a new approach towards a peer group composition – the so-called Kernel-based approach. This approach relies on the traditional industry/size method introduced by Albuquerque (2009). Aggregating in this manner accounts for the observation that industry affiliation and firm size are informative proxies for the common market risks that RPE-setting firms face. However, our approach is more adjustable in terms of firm size. Instead of fixed-size peer groups, each firm in the sample is assigned a unique, individual peer group based on the firm's size. We argue that this approach is better able to capture exogenous shocks on the market than the traditional industry/size peer group. To that end, we test the RPE hypothesis on a large sample of 2806 U.S. firms from 1992-2011. We aggregate peer performance by using the classical industry and industry/size approaches and juxtapose them to our novel Kernel-based peer group approach. We document the negative and statistically significant parameter estimates on the Kernel-based peers and the industry/size peers, which is consistent with the RPE use in executive compensation. There are differences in explanatory power, however. The peer coefficients on the Kernel-based peers are more negative as to the industry/size peer group approach. This is an indication that the Kernel-based method is better able to filter out exogenous shocks from the level of executive pay in comparison to the industry/size method. We also examine if there is an association between firm's performance and their tendency to use RPE, proxied by the "predicted excess compensation" variable that arises from the firm and peer performance. Our evidence suggests that there is no such association. However, this remans an intriguing question for future research.

# Chapter 1

# Relative Performance Evaluation: A Survey

### Chapter Overview

This paper provides a review of the empirical literature on relative performance evaluation (RPE). The RPE theory suggests that a manager's performance should be evaluated relative to a peer group. In this manner, not only is the manager insulated from the common shocks, unrelated to his performance, but the board is also better able to evaluate manager's performance. Hence, the RPE theory has important practical implications for the executive compensation contract design. Against this background, the knowledge stemming from the academic literature on RPE reveals important insights about executive contract practices. This paper demonstrates that main findings with respect to the RPE use in the executive compensation contracts are inconclusive. However, it appears that many studies ignore strategic interactions between firms which creates a bias in the RPE tests. In addition, ignoring executive characteristics such as CEO talent, wealth, and age or his power over the board of directors might lead to the failure to detect RPE. Strategic flexibility in making decisions about a firm's strategy may make contracts without RPE optimal for the shareholders. Inappropriate firm performance measures and misspecified peer groups also affect inferences drawn on RPE. The academic literature suggests that firms consider both benefits and costs when implementing RPE. This might be observed when analysing how different firm characteristics drive the use of RPE. The findings with regard to RPE in the CEO turnover decisions seem to be more convincing at the first glance. However, some researchers pinpoint methodological issues of these studies, and therefore, offer suggestions on how to improve the research design on CEO turnover decisions in the context of RPE.

## 1.1 Introduction

The principal-agent theory predicts that basing an agent's compensation on relative performance offers benefits for both the principal and the agent. Basing an agent's compensation on absolute firm performance measures induces unnecessary risk into his contract.[1] These measures contain common risk components, which are beyond the agent's control and unrelated to his effort. Therefore, evaluating a risk-averse agent on such performance metrics induces uncertainty into his compensation contract. In order to overcome this problem a theory of relative performance evaluation (RPE) suggests basing agent's compensation on one additional variable – peer performance. Such compensation contract does not contain the common risk component (Holmstrom 1979, 1982). Consequently, it insulates the agent from common uncertainty and also provides a better evaluation of the agent's effort.[2] However, RPE might also impose certain costs. The presence of RPE in the compensation contract might alter agent's incentives whenever he can affect the peer performance. In particular, as noted by Gibbons and Murphy (1990, p.30-31) he might be induced to collude and shrink with co-workers or to obstruct the performance of the peer group members. Moreover, when the performance of the peer group members is difficult or expensive to measure, the RPE contracts are not advantageous anymore (Gibbons and Murphy 1990, p.31). The tournament theory also predicts that the heterogeneity among agents might mitigate the benefits of RPE (Lazear and Rosen 1981). For example, Lazear and Rosen (1981) show that agent's risk choices might alter his incentives as soon as the agent finds out that he has unequal chances to win the "award" in a tournament.

Relative performance evaluation has most widely been tested in executive contracts. This comes as no surprise as its main features make it a good case for testing RPE hypothesis. The risk-sharing benefits of RPE in these contracts are more likely to outpace its costs to the shareholders (Gibbons and Murphy 1990, p.31). For example, the stock performance of the peer firms are easily accessible and available on low-cost daily basis. In addition, the chief executive officer's (CEO) linkage with other CEOs on the market is weaker in comparison to other lower-level employees (Gibbons and Murphy 1990, p.31). This decreases the chances of diluting the performance of the peer group constituents. Taking this into consideration, the implementation of RPE in executive compensation does not seem expensive (Gibbons and Murphy 1990, p.31).[3] Hence, CEO pay makes it a good case for testing RPE. However, the use of RPE has not been limited to this component of the compensation contract only. Many studies examine the conditions in which the CEO is forced or encouraged to leave the firm. Precisely, they examine whether boards filter out exogenous shocks when deciding to retain a CEO.

Given the obvious benefits the RPE offers in terms of executive contracts, it comes as no surprise that many researchers have decided to empirically test the theoretical prediction of RPE. Against this background, I argue that the main findings stemming from the empirical literature on RPE in the context of executive contracts bear important insights

[1] Jensen and Meckling (1976), Holmstrom (1979), Fama (1980), Shavell (1979) and Ross (1973) contributed to the development of the agency theory.

[2] The seminal papers by Holmstrom (1979), Holmstrom (1982) have set a theoretical background for the RPE.

[3] For more details on the benefits and costs of RPE, see Gibbons and Murphy (1990).

relevant for both academics and public. First, they offer an explanation for the so-called RPE puzzle. The RPE puzzle is a phrase often used by academics to denote the scarce evidence of RPE in the empirical literature on executive compensation. For example, Murphy (1999, p.2539) notes that "... the paucity of RPE in options and other components of executive compensation remains a puzzle worth understanding." Moreover, Hall and Liebman (1998, p.683) add that "the near complete absence of relative pay seems to be a puzzle". Some researchers refer to the lack of RPE in the executive pay as a stylized fact (Celentani and Loveira 2006). To that end, over the last two decades several branches of academic literature have evolved offering potential explanation for this case. Insights from these studies matter because their findings affect the inferences drawn on the RPE use. Second, academic literature provides evidence on how the firm's decision to explicitly use RPE is related to the firm's characteristics, suggesting that firms consider both benefits and costs when deciding to commit to the RPE use. Third, studies examining whether boards base their decisions to dismiss a CEO on his relative performance, provide important insight about the governance practices. To that end, I collect around 50 empirical studies on relative performance evaluation from 1986 to the present day and summarize their main findings. Thus, the aim of this paper is to provide a state-of-the art literature review on relative performance evalation.

In the first part of the paper I review the main insights from the studies that examine whether the executive compensation contracts are based on RPE. Following the literature I differentiate between the weak-and strong-form tests of RPE. The weak tests examine if *some* of the exogenous shocks were removed from the compensation contract, while the strong-form tests indicate if *all* the shocks are filtered from the compensation. Alternatively, researchers also distinguish between the implicit tests of RPE that infer a peer group performance, and explicit tests which use information disclosed in the firms' proxy statements and annual reports in order to proxy for peer performance. I conclude this section by outlining that the academic literature provides scarce and inconclusive evidence with regard to the RPE.

Such evidence has given rise to what has been known as the RPE puzzle. Many streams of literature have evolved aiming to explain the existence of this puzzle. This is in the focus of the second section. One branch demonstrates that executive characteristics play a role in drawing inferences with respect to RPE. During the bull markets, the demand for talented CEOs increases. In the same time peer performance against which a CEO performance is benchmarked also rises, making RPE contracts less attractive. So, if a firm wants to keep a talented manager, she might want to offer him a contract without RPE in order to keep him in the firm. In this situation, no RPE is in fact optimal (Rajgopal et al. 2006). The more wealthy and elderly CEOs are disposed to less RPE as they find it easier to privately hedge on their account than the young ones (Garvey and Milbourn 2003). Another branch of the literature suggests that misspecified RPE models are the reason why we observe so little empirical support for RPE. Namely, many studies do not use appropriate peer performance benchmarks in examining RPE (Albuquerque 2009, Black et al. 2015, Gong et al. 2011, Jayaraman et al. 2015, Hoberg and Phillips 2015, Lewellen 2015). The industry/size, the product market-based peers and the so-called "self-selected" peer groups seem to be better proxies for peer performance than

traditional industry or market benchmarks. Other studies argue that firms use inappropriate firm performance metrics when testing RPE (Alanis 2015, Angelis and Grinstein 2016). The firms' strategic interactions in an oligopolistic environment seem to affect inferences drawn on RPE. In such market, RPE appears to be too costly – it induces managers to collude which undercuts shareholders' returns (Aggarwal and Samwick 1999a, Joh 1999, Janakiraman 2004). Furthermore, I review studies that argue that managerial power over the board of directors leads to the lack of RPE in CEO pay. Namely, managers exert their power to influence the decisions made by the board and therefore affect the pay-setting process. Hence, we observe asymmetric performance benchmarking in the CEO pay, which is inconsistent with the RPE theory (Bertrand and Mullainathan 2001, Garvey and Milbourn 2006, Bell and Van Reenen 2016). Finally, a managerial flexibility in determining the firm's strategy through the exposure to the sector performance might make RPE contracts suboptimal (Gopalan et al. 2010).

In the third part of the paper, I discuss studies that examine how the use of RPE in the CEO pay is related to different firm characteristics. Firm's decisions to explicitly use RPE varies with the firm size, the level of growth options, common risk the firm faces, investment in research&development costs but also with whether the firm belongs to a concentrated industry or not. Moreover, the amount of CEO equity holdings and the number of independent directors play a role in determining the RPE use. Furthermore, the presence of compensation consultants also affects RPE tests (Kren 2002, Albuquerque 2014, Gong et al. 2011, Keune 2015, Liu 2008, Jaiswal and Bhattacharyya 2016). Better accounting regulation, International Financial Reporting Standards in particular, seems to induce the accounting-based RPE use due to better accounting information and comparability (Wu and Zhang 2010). Another studies find that many conditions that influence RPE tests on the firm-level are more strongly related to the RPE conditions at the compensation plan level (Carter et al. 2009). Hence, before making decisions on whether to implement RPE, firms evaluate both its benefits and costs (Gibbons and Murphy 1990, Gong et al. 2011).

In the final part of the paper, I examine whether boards evaluate CEOs based on their relative performance when deciding whether to retain them in the firm or not. At the first glance, the results of the studies seem to be more conclusive than the studies examining the same hypothesis in executive pay (Warner et al. 1988, Gibbons and Murphy 1990, Barro and Barro 1990, Blackwell et al. 1994, Chen et al. 2005). However, a closer look reveals that academic literature has mostly relied on the weak-version RPE tests. When the strong-form tests are employed the evidence with respect to RPE are less convincing (Jenter and Kanaan 2015, Barakova and Palvia 2010). Moreover, some piece of evidence indicates that previous studies have been too conservative when defining a CEO turnover, affecting the inferences drawn on RPE (Fee et al. 2015). Taken together, these results provide insights for the research design of the future studies that intend to address the issue of CEO turnover in the context of RPE.

The reminder of the paper is organized as follows. Section 1.2 reviews studies investigating the presence of RPE in executive compensation contracts and acknowledges that academic literature has offered mixed and inconclusive results with respect to RPE. Such results have given rise to what has been known as the RPE puzzle in the academic literature. Hence, Section 1.3 discusses several possible explanations for this case. Section 1.4

examines how the use of RPE is related to the firm's characteristics. Section 1.5 discusses studies examining RPE in the context of CEO turnover. Finally, Section 1.6 concludes.

## 1.2 Are executive compensation contracts based on relative performance?

The concept of relative performance evaluation has been widely examined in the context of executive compensation. Therefore, it is the purpose of this section to chronologically review the main results of these studies.

In order to empirically test whether executives are compensated based on relative performance, academic studies typically regress the total executive pay, or one component of executive pay, on firm and peer performance measures.[4] A negative and statistically significant coefficient on peer performance suggests that the systematic component of firm performance is removed from the compensation, implying the RPE use. The RPE tests that infer RPE by using some proxy for peer group performance such as market or industry index are called *implicit* or *indirect*. As of 2006 it is possible to conduct the so-called *explicit* or *direct* tests of RPE. Namely, due to the regulation change that took place in the U.S., researchers are able to observe compensation practices of firms in more detail. This allows them to collect information on the peers that firms select in performance benchmarking. Therefore, instead of market and industry indices, researchers use the so-called "self-selected" peers in order to construct peer performance measures. The *weak-form* RPE empirical specification examines if some of the common shocks are removed from the compensation contract. On the other hand, the *strong-form* version of RPE examines whether common shocks are completely removed from executive contract. In other words, it tests if a performance evaluation of an executive is solely based on the "unsystematic" component of firm performance.[5]

The study by Antle and Smith (1986) opened an empirical inquiry of the validity of the main theoretical prediction of RPE. The study conducts strong-from RPE tests on the sample of chemical, aerospace and electronics firms in the U.S. from 1947-1977. Sample-wide the authors find weak evidence of RPE. However, when they conduct regression analysis on firm-by-firm basis, the RPE support is found in 16 of 39 sample firms. The results also suggest that RPE tests are sensitive to the firm performance measures. Namely, Antle and Smith (1986) find weaker evidence of RPE when using return on common stock as a firm performance measure, while the tests have a stronger power when return on assets is employed. Even though the study did not provide conclusive results on the RPE use in executive pay, it set foot for the future studies that are to plunge deeper in the topic of RPE. In contrast to Antle and Smith (1986), Barro and Barro (1990) examine RPE hypothesis in the banking industry. Precisely, they gather data on 83 U.S. commercial banks that were ranked highest in terms of firm's assets in 1986. They first regress the

[4]Depending on the sample in question additional control variables are included in the empirical specification.

[5]The empirical specifications for both weak-form and strong-from tests are presented in Chapter 2 and Chapter 3.

growth rate of real compensation $log(\frac{w_{it}}{w_{it-1}})$ on the first difference of accounting returns and market-based real rate of returns and their corresponding regional returns. In similar manner, the authors regress the same dependent variable on the relative performance variable written as a function of firm and peer returns. On the basis of data from 1982-1987 the authors fail to find evidence consistent with RPE. They argue that this result might well stem from the misspecified peer groups that are based on the geographical region, which might not be a good proxy for capturing systematic shocks. A seminal study by Jensen and Murphy (1990) brought important insights about executive pay-performance relationship to the academics, and public in general. Even though the authors do not explicitly test RPE, they examine pay-performance sensitivity using additional performance measures – net-of-industry shareholder wealth change, and net-of-market shareholder wealth change.[6] They find that pay changes are not sensitive to these relative performance measures, indicating no RPE in the sample they examine. In attempt to address the issue of whether common uncertainties are removed from executive pay, Gibbons and Murphy (1990) employ a sample of 9425 observations which includes 1668 executives from 1049 firms in 1972-1986. Contrary to the previous studies, they find that common risks are partly filtered from executive pay when using industry and market peer returns. Yet, results seem to suggest that an executive is more likely to be evaluated relative to the market than to the industry peers. The robustness checks confirm these results and show that the explanatory power of the model diminishes as the industry definition becomes more narrow. This evidence is explained as a consequence of the sample firms not being employed in one industry only. It is also possible that the SIC industry definitions are not a satisfying proxy for industry peers (Gibbons and Murphy 1990).

This, however, stands in contrast to the study conducted by Janakiraman et al. (1992). The authors find weak evidence of RPE in the sample of 609 firms over the period 1970-1980. Namely, CEO cash compensation (salary+bonuses) is positively related to the accounting return on equity (ROE) and not related to the industry ROE – no evidence of RPE. The authors use both strong-and weak-form of RPE. The results do not change significantly when market-oriented firm performance measures are employed. As argued by the authors, this might well be the result of RPE not being relevant from the firm's perspective or it might also be perceived as pricey. Another possible explanation brought up by the authors is that RPE theoretical model is not well adapted to the CEOs. These results are fortified by the study conducted by Garen (1994). He attempts to evaluate whether executive pay is consistent with the theoretical predictions of principal-agent model. Against this background, he uses another means to test the empirical validity of the predictions – the method of comparative statics. Some of the empirical results remain consistent with the predictions of the principal-agent theory. However, this is not the case for RPE. Its use seems limited in the sample of 415 U.S. firms. He finds that stock, stock-option based and pay-based incentives are not structured to adjust for market risk.[7] Crawford (1999) examines the U.S. banking CEO compensation in the light of banking deregulation that occurred in the industry in the early 1980s. The data gathered

[6] Jensen and Murphy (1990) gather data on 1660 CEOs in 1049 firms from 1974-1986.

[7] Garen (1994) defines pay-based incentives as the pay that remains once the salary, bonus and long-term incentive components are deducted from the total pay.

from 1976-1988 suggest that CEO banking pay is adjusted for both industry and market performance. In addition, the study implies the use of RPE become more prevalent after bank deregulation. The authors propound the view that RPE offers a significant reduction in the compensation costs, providing incentives for the banking industry to increase its use. Similar to previous studies, Aggarwal and Samwick (1999b) test the predictions of principal-agent theory in the context of executive pay. In particular, the issue under scrutiny is how sensitivity of pay-performance relation varies with the firm risk proxied by the variance of the firm's performance. In addition, they test theoretical predictions of RPE, and also whether CEOs working in the industries with a low risk, or in the firms with a high covariance between industry and firm returns are more prone to the RPE. Following theoretical predictions from the principal-agent theory, they expect to find strong evidence of RPE in executive pay when firms in the industry have a greater tendency to use RPE or when the covariance with the industry is significant. They test both weak-and strong-form tests of RPE and modify the standard empirical specification by including the variance of the idiosyncratic shock to the firm performance.[8] Aggarwal and Samwick (1999b) find weak evidence for their hypothesis, lending no support for RPE.[9] The studies by Murphy (1999) and Bannister and Newman (2003) examine the explicit RPE use in the CEO compensation contracts and provide a descriptive statistics about executive compensation contracts that entertain the use of RPE. For example, Bannister and Newman (2003) document that 28% of 160 Fortune firms in 1992 and 1993 report the use of RPE in some parts of the CEO compensation.

Most of the studies investigating RPE are focused on the U.S market. This comes as no surprise given the data unavailability in some countries outside the U.S. An exception to this rule are studies conducted by Liua and Starkb (2009) and Farmera et al. (2011). They address the issue of RPE on the U.K. market. Liua and Starkb (2009) perform tests of RPE on cash compensation of the executive board. In an attempt to implicitly test RPE, the authors gather data on 169 non-financial listed firms from 1971 to 1998. The authors first run individual firm time series regressions of the change in board cash compensation against firm and peer group performance. They use annual cash stock market returns and pre-tax accounting earnings as performance metrics. Consequently, peer group performance is represented by industry value-weighted average stock market returns and industry value-weighted average pre-tax accounting earnings. The evidence suggests the presence of RPE only when the accounting-based measures are used. In contrast to these results, a study conducted by Farmera et al. (2011) finds a more convincing evidence, corroborating the notion of RPE. Namely, they find that 204 non-financial UK firms use

[8] In particular, the authors incorporate a variable for firm performance that depends on the cumulative distribution function (CDF) of the idiosyncratic variance. The same applies for the industry performance. Apart from these two variables, they incorporate the interaction between industry performance and CDF of the idiosyncratic variance, the interaction between industry performance and firm's stock $\beta$, and industry performance interacted with both firm's $\beta$ and CDF function in the empirical specification. For more details on the empirical model they employ, see p. 95 in Aggarwal and Samwick (1999b).

[9] In another paper, the authors offer a theoretical explanation for the lack of RPE in the academic studies. The theoretical predictions are followed by the empirical analysis. This paper is discussed in more details in Section 1.3.3.

RPE in determining the level of short-term and long-term executive pay.[10]

Furthermore, De Angelis and Grinstein (2011) examine executive pay contracts of 494 firms that constitute S&P 500 Index in 2007, a year after the new rule with respect to executive compensation disclosure was enacted in the U.S. They investigate how widespread the RPE use is as well as what determines it. They find that 34% of the firms report the RPE use in executive compensation in their proxy statements. The study also reports that firms committed to the RPE use tie 49% of the estimated value of performance-based awards to RPE. In doing so, most of the firms use market-based performance measures. In addition, 61% of the firms use self-selected peers, whereas the rest of them use industry or market indices.[11] A study by Gong et al. (2011) goes a step further and incorporate the contract details into RPE tests. They collect contract details based on what is disclosed in the annual reports and proxy statements, and build a peer group based on the self-selected peers that are disclosed in these contracts. Peer performance is denoted as a median stock return of the peers reported in the 2006 proxy statement. A closer look at the sample of 1419 (S&P 1500) firms provides convincing evidence of the RPE presence.

Another studies that foster research on RPE in the markets other than the U.S. are Chen et al. (2012) and Cai and Zheng (2016). Chen et al. (2012) use Shanghai and Shenzhen A-share listed companies from 1999 to 2009 – a total of 10724 observations. In the full sample there is no compelling evidence of RPE use. However, when they differentiate between SOEs (State Owned Enterprises) and non-SOEs (non-State Owned Enterprises) they find that the latter has a higher tendency to use RPE, indicating that type of ownership matters in structuring executive pay. Chen et al. (2012, p.129-130) argue that this might be a consequence of different compensation regulation between SOEs and non-SOEs such as non-SOEs having a cap, more market-based performance measures, having minor exposure to the government intervention or SOEs having various additional incentives. Finally, Cai and Zheng (2016) examine executive incentive mechanisms in the subsidiaries of business groups in China.[12] The authors analyze subsidiaries' executive compensation in the 271 business groups in China from 2003-2011 – a total of 4124 firm-year observations. They report that executive pay in the subsidiaries is determined by its own performance and the performance of other subsidiaries in the business group or their relative performance ranking. Yet, the RPE use seems to be more prevalent in the business groups that are privately owned, consistent with Chen et al. (2012).

Taken together, empirical literature on RPE in executive pay is vast. However, it provides mixed and inconclusive evidence. Moreover, the RPE tests seem to be sensitive to the firm performance measure and empirical specification. This gave rise to what has

[10]Short-term executive pay is adjusted for the FTSE-350 market performance, whereas the long-term is adjusted for industry performance, FTSE-350 sector performance.

[11]The authors acknowledge that it is possible that studies reporting the RPE use do not actually entertain it in practice. In order to address this issue, De Angelis and Grinstein (2011) empirically test RPE using the traditional empirical specification. As a dependent variable they choose a component of CEO pay that is tied to RPE according to the firms' proxy statements. They find evidence consistent with RPE when this measure of CEO pay is included in the regression. On the contrary, when the authors employ total pay as dependent variable they report evidence inconsistent with the RPE use. The authors interpret this as an indication that RPE disclosures are informative.

[12]Cai and Zheng (2016) report that 76% of listed companies were in the hands of business groups as of 2011.

been known as *RPE puzzle* in the academic literature. On this account, many researchers address this issue and offer several possible explanations.

## 1.3 The RPE puzzle – possible explanations

Murphy (1999) and Abowd and Kaplan (1999) recognize a lack of empirical evidence with respect to RPE as an important unresolved puzzle in the academic literature on executive pay. This puzzle persists to this day. However, many streams of literature have emerged offering plausible explanations for its existence. On this account, in this section I review these branches of literature and group them based on the type of explanation they offer.

### 1.3.1 Executive Characteristics and Relative Performance Evaluation

To explain inconsistent results, several studies attribute the lack of RPE in the empirical literature to the ignorance of CEO characteristics such as CEO talent (or CEO outside opportunity), CEO age and his wealth in conducting RPE tests (Rajgopal et al. 2006, Garvey and Milbourn 2003).

Some theoretical studies reveal the role the CEO talent plays in the design of CEO pay (Holmstrom 1999, Oyer 2004, Lazear and Rosen 1981). For example, a study by Oyer (2004) hypothesize that the lack of RPE in executive pay might be a consequence of an executive outside opportunity that is sensitive to the market movements. The author shows that it is optimal to offer an executive a higher wage (without RPE) in the light of booming markets, as demand for talented CEOs as well as peer performance (against which a CEO performance is benchmarked) increase during this time. Against this background, given that the CEO talent is scarce, it is in the interest of shareholders to award a CEO with the higher reservation wage in order to retain him in the firm. Under these circumstances, no RPE might be optimal for the shareholders. This theoretical prediction has found an empirical support in the academic literature. Namely, Rajgopal et al. (2006) build two proxies for CEO talent: 1. the number of articles in which a CEO's name appear 2. firm's past industry-adjusted accounting performance.[13] They then argue that the more talented CEOs are more likely to exhibit higher industry adjusted performance and are also more likely to be mentioned and cited in the business newspapers. The authors then regress the change of CEO's pay against the realized shareholder return, industry performance, the interaction term of industry performance and the CEO talent in order to examine if CEO talent is related to RPE.[14] The authors expect positive and statistically

[13] In order to make sure that the number of articles is not a reflection of a CEO's disrepute, Rajgopal et al. (2006, p.1814) code the tone of the articles, check the correlation between the number of articles and reputation, and examine if the number of articles is correlated with the so-called explicit recognition by the public.

[14] In addition, the authors include the interaction of shareholder return and several other control variables, industry and year dummies in the empirical specification. Industry performance is proxied with the hypothetical shareholder return if the company had earned the industry return.

significant coefficient on the last mentioned variable.[15] Indeed, the available evidence seems to support their expectation – the lack of RPE is related to the CEO talent.[16] Further evidence supporting Rajgopal et al. (2006), lie in the findings of Gopalan et al. (2010).[17]

In the study by Garvey and Milbourn (2003), the issue under scrutiny is whether and how managerial costs of accommodating his investment portfolio affect RPE tests. Traditional RPE models presume that these costs are too high and therefore, ignore them in the model specifications. To that end, Garvey and Milbourn (2003) introduce a RPE model that allows for managerial hedging of market risks. The model admits that hedging can be personally costly to the managers and that RPE can induce costs to firms. The results of the model imply that RPE use diminishes with the drop in the managerial hedging costs. To empirically test the model prediction the authors first examine if the 1400 large U.S. firms entertain the RPE use over 1992-1998.[18] On average, they find little support for RPE. However, they use managerial age and financial wealth in order to examine how RPE relates to managerial costs. The authors report strong evidence consistent with RPE for the young and less wealthy managers. Interestingly, the wealthiest managers do not seem to have RPE in their compensation contracts. The authors put forward the view that elderly and more wealthy managers find it easier to privately hedge on their account. Hence, "the practice of relative performance evaluation seems to reflect the firm's comparative advantage in providing insurance from market risks, relative to the executive doing it for herself" (Garvey and Milbourn 2003, p.1580).

To sum up, CEO characteristics such as CEO talent, his age and wealth play a role in detecting RPE. It seems that the use of RPE is not optimal for shareholders when demand for talented CEOs is high during the bull markets. In addition, the more wealthy and elderly CEOs are prone to less RPE as they find it easier to accommodate their portfolio.

### 1.3.2 Peer Groups and Relative Performance Evaluation

Studies by Gibbons and Murphy (1990) and Barro and Barro (1990) were among the first ones to note that inferences on RPE might be sensitive to the peer group composition.[19]

On this account, Albuquerque (2009) investigates how the choice of peer groups affects RPE tests. She argues that solely relying on an industry or market index as a measure of peer performance introduces noise in the tests of RPE. Industry and market indices are broad measures of peer performance especially in significantly heterogenous industries (Albuquerque 2009). As a consequence, she argues that such peer performance proxies fail to capture exogenous shocks appropriately. This affects the RPE tests. Albuquerque

[15]The lack of RPE is assumed as the absence of strong-from version of RPE in the data.

[16]Rajgopal et al. (2006) use the sample of 2343 CEO-firm-year observations from 1993-2001. The results seem to be robust to alternative explanations found in the literature – strategic interactions, rent-seeking behavior and asymmetric benchmarking.

[17]Gopalan et al. (2010) use the following proxies for the CEO talent: industry adjusted return, an indicator variable on whether a CEO is hired from the outside, stock return of the external CEO's previous firm.

[18]The sample consists of 6488 CEO-firm years observations.

[19]This argument is latter on analytically supported by Dikolli et al. (2013). They analytically demonstrate that differences in peer group aggregation methods lead to complicated summarization errors. Such errors then create a bias against finding support for strong-form RPE tests.

(2009) argues that firm size is an important firm feature that is able to capture many of firm characteristics and that, as such, it should be included in the peer group construction. To that end, she builds an industry/size quartile peer groups and compares its power in detecting RPE to the "traditional" measures of peer performance – S&P 500 Index and SIC industry indices. In order to test what peer group is better able to capture exogenous shocks, she regresses the total level of compensation (and change in total compensation) on the firm stock performance and different proxies for peer performance separately.[20] There is overwhelming evidence corroborating the notion that industry/size peers are better able to capture exogenous shocks than traditional market and industry indices.[21] Black et al. (2015) reinforce this evidence. Namely, the authors examine RPE disclosure of S&P 500 firms. The study documents that 17.32% of firms report the RPE use in determining executive compensation. Moreover, they find evidence consistent with RPE for the full sample when using industry/size peers developed by Albuquerque (2009) and industry peers. Consistent with Albuquerque (2009), industry/size peers seem to be the most powerful in detecting RPE. In order to disentangle whether the peer choice affects the RPE use and whether the RPE disclosure is indeed trustworthy, the authors break down the full sample into RPE users and non-RPE users and conduct both explicit and implicit RPE tests on both subsamples. Consistent with expectations, they implicitly detect RPE in the subsample of RPE disclosure firms.[22] The authors, however, detect RPE use in the subsample of non-RPE disclosing firms when employing implicit test of RPE and industry/size peer groups. This is regarded as an indication "that relying on explicit disclosures of RPE may understate the prevalence of RPE in practice and that implicit tests for RPE can be important in detecting both RPE and general compliance with regulations to disclose RPE details" (Black et al. 2015, p.5). Taken together, the authors report that the industry/size quartile peer approach and the explicitly-disclosed peers represent powerful methods for capturing exogenous shocks.

On the contrary, Gong et al. (2011) fail to find evidence consistent with RPE when using the above mentioned industry/size peers in their sample of 1500 S&P firms in 2006.[23] This result also holds in the subsample of firms that disclose the use of RPE in the compensation contracts, which is one quarter of the sample. Among the RPE disclosing firms, almost 60% use self-selected peer groups, 35% employ traditional peer group methods (industry and market indices), whereas 7% entertain both approaches (Gong et al. 2011, p.1016). Yet, when they employ a self-selected peers as a measure for peer performance, they are able to detect evidence of RPE use.[24] In particular, the authors use the median stock return of disclosed peers in 2006 firms' proxy statements as a measure for peer performance. These findings suggest that incorporating RPE contract details with respect to peer group increase the power of the RPE tests. Hence, the RPE tests are sensitive to

[20] In addition, she controls for several firm characteristics, governance measures, year, industry and CEO dummies.

[21] Statistically speaking, the coefficient on industry/size peers is constantly more negative and statistically significant than this is the case with industry and S&P 500 peers. This result is robust to several other empirical specifications.

[22] This evidence is stronger in comparison to the full and non-RPE subsample.

[23] The sample consists of 1419 firms. There are 361 RPE firms and 1058 non-RPE firms in the sample.

[24] Put it differently, the authors employ the so-called explicit RPE tests.

peer group construction and self-selected peers seem to be most powerful in capturing exogenous shocks.

Another study that infers the importance of peers in drawing inferences about RPE is Jayaraman et al. (2015). Following Hoberg and Phillips (2015), they argue that traditional industry indices that are based on SIC classification are not able to seize main features of firm's product markets due to the fact that they seldom change over the years. Similar to Albuquerque (2009) authors reason that traditional industry approach is not well-suited for firms that belong to significantly heterogenous industries. The authors, however, offer an alternative to peer group composition – product market-based peers. Firms operating in the same product market face similar demand and supply, share similar customers, use similar input supplies, and etc (Jayaraman et al. 2015, p.2). For these reasons, they choose peers on the basis of textual analysis of firms' product descriptions in 10-K filings in order to examine their power to capture exogenous shocks. More precisely, they exploit Text-based Network Industry Classification (TNIC) introduced by Hoberg and Phillips (2015), which hinge on product similarities of firms.[25] Jayaraman et al. (2015) then constitute quartile portfolios which are based on the firm size and book-to-market within each firms TNIC industry. Therefore, the firms that belong to the same quartile portfolio represent the peers. They then further calculate the equal-weighted stock return which represents the peer performance proxy. Using 19105 firm-year observations from 1996 to 2011, the authors compare the product market based peers with the traditional industry peers, based on SIC classification, and report stronger RPE evidence when using their measure of peer performance. In addition, it seems that filtering of exogenous shocks increase with the number of peers. With a sufficiently large number of peers, the external shocks seem to be removed completely, which is consistent with the predictions of the optimal contract theory. In similar fashion, Lewellen (2015) creates peer groups that are also based on product market competition. However, his approach towards peer group composition is somewhat distinct from the one used in Jayaraman et al. (2015). He also uses annual 10-K filings from 2002-2008 where firms are required to report their product market competitors by federal law. However, he does not employ textual analysis algorithm in creating peer groups but solely relies on the information provided in the 10-K fillings. After collecting peers, author then calculates equal-weighted stock returns in order to proxy for peer performance.[26] The author denotes these peer groups as firm-specific industries (FSIs). He reports strong evidence supporting the use of RPE in executive compensation when peer groups are based on FSIs in the sample of 17021 firm-year observations. On the other hand, Lewellen (2015) contends that the lack of empirical evidence on RPE stems from the peer group misspecification.

Taken together, the peer group choice seems to affect the inferences about RPE. The aforementioned studies demonstrate that industry/size and product market-based peers seem to be better in filtering out exogenous shocks from the compensation contract than

[25]Hoberg and Phillips (2015) gather business descriptions from 10-K filings and by means of textual analysis create the co-called "text-based network industry classifications" (TNICs). These classifications then reflect the firms' product markets characteristics as disclosed in the 10-K fillings.

[26]The author chooses to assign equal weights on every peer as Regulation Law requires firms to list only dominant competitors.

the traditional industry benchmarks. The number of peers within the peer groups also seems to have merit in detecting RPE. Finally, self-selected peers seem to have a greater power than industry/size peers in drawing inferences on RPE.

### 1.3.3 Relative Performance Evaluation and Strategic Interaction

Some studies suggest that strategic interactions between firms might make RPE a suboptimal incentive device (Aggarwal and Samwick 1999a, Joh 1999, Janakiraman 2004).

Aggarwal and Samwick (1999a) comprehend that the presence of RPE in executive compensation contracts might incentivize executives to collusive behavior. Such behavior reduces the peer return, leaving the CEO with higher reward. This behavior might be especially prevalent if the firms in the industry are strategic competitors in the product markets. In order to examine the effect of strategic competition on RPE, Aggarwal and Samwick (1999a) model product market competition and derive the optimal compensation scheme. In their paper product market competition is modelled twofold: the outputs are strategic complements or strategic substitutes. Depending on the formulation of the product market competition the model delivers different results with respect to RPE. In the first case, RPE is not observed in the equilibrium as its presence induces managers to compete more aggressively on the market where the competitors are strategic complements, which can harm firm's returns (Aggarwal and Samwick 1999a, p.2001).[27] In the optimal contract, the level of compensation raises with the firm and industry return, thereby weakening the competition in the product market and reducing manager's incentives to compete aggressively on the market (Aggarwal and Samwick 1999a, p.2001). On the contrary, in the second case, the model predicts that under the optimal contract design the level of compensation increases with the firm performance but decreases with the industry returns. As pointed out by the authors, this model is consistent with the predictions regarding RPE. However, the contract is not motivated by the principal-agent relationship but rather by the firm's strategic choice (Aggarwal and Samwick 1999a, p.2002). Aggarwal and Samwick (1999a) empirically test both of these predictions.[28] Empirical results in the U.S. sample from 1992-1995 support the strategic complements model. Namely, the authors find little evidence of RPE – compensation is positively related to the firm as well as to the peer performance.[29] As noted by the authors this result suggests that lack of empirical evidence on RPE might well be explained by the firms' strategic interactions in an oligopoly. In such environment, RPE is costly – it induces managers to collude which undercuts shareholders' returns.[30]

In similar manner, Joh (1999) contends that firms operating in an oligopolistic market could acquire collusive returns that are higher than competitive equilibrium returns. In

[27] The authors employ the differentiated Bertrand model of price competition.

[28] As a proxy for product substitutability, the authors use the industry Herfindahl Index. The index varies from 0 to 10000 and is defined at the four-digit SIC level as the sum of squared market shares for the largest 50 firms in the corresponding industry (Aggarwal and Samwick 1999a, p.2015).

[29] The authors, however, find some evidence of RPE in the short-term compensation. Yet, this evidence seems to be restricted by the strategic interaction.

[30] The study by Cheng and Xu (2006) also provides some piece of evidence that competitive environment affects managerial incentives.

oder to achieve this, shareholders can use industry performance within the compensation scheme as a commitment device for executives to cooperate with the rivals (and obligate to collusive behavior) (Joh 1999). Under such compensation scheme, executive pay is "directly related to the success of the collusive outcome" (Joh 1999, p.304). In this manner the CEO is incentivized to keep up with the market collusion, which is the intention of shareholders. Thus, the inconclusive results regarding RPE might stem from the shareholders' decisions to strategically tie executive compensation (positively or negatively) to industry performance in an oligopolistic markets (Joh 1999, p.304). Indeed, a closer look on 796 Japanese firms from 1968 to 1992, indicates that shareholders in an oligopoly can strategically use RPE or the so-called "strategic group performance evaluation" (SGPE) in executive compensation contracts, depending on what they want to achieve. The author delivers such results by examining how the market growth and seller concentration affect RPE tests. In particular, the author includes additional variables in the traditional RPE empirical specifications: the interaction term between industry performance and market growth, proxied by the annual industry sales growth rates, and the interaction term between industry performance and seller concentration, proxied by the Herfindahl Index.[31] The firms belonging to the competitive and slow growing markets seem to exhibit a higher degree of SGPE in compensating their executives. On the contrary, higher degree of RPE is reported in more concentrated and fast-growing firms. These results are consistent with the above mentioned arguments – the firms might not be incentivized to use RPE in the competitive markets when the outcomes of product market collusion might be significant.

To briefly recap, the RPE appears to be sensitive to product market competition. The RPE use seems to be too costly for shareholders when the products on the market are strategic complements. In a situation when the collusive outcomes are higher than the competitive returns, the board might use executive pay to promote the collusive beahvior. In this case, RPE use is not optimal from the shareholders' perspective.

### 1.3.4 Relative Performance Evaluation and Managerial Power Hypothesis

According to the proponents of the managerial power hypothesis or the so-called skimming model, managers use their power over boards to extract more favourable compensation schemes than they would be able under the optimal contracting view.[32] Bebchuk and Fried (2004) discuss several reasons why the board might be too weak or powerless to oppose the executive. For example, board members might actually have financial and non-financial incentives to please executives rather than to constrain them. In addition,

[31] In order to evaluate this, the author employs both weak-and strong-form versions of RPE.

[32] Bebchuck and Friend are probably the most famous bemoaners of executive compensation. In their book *Pay without Performance: The Unfulfilled Promise of Executive Compensation*, Bebchuck and Fried argue that the rise in executive pay has been widespread and systematic. Moreover, they argue that there are serious flaws in the current U.S. corporate governance system, which allow executives to exert influence on the board of the directors, and thereby influence the level of their pay. They develop their own paradigm – managerial power hypothesis – that explains the current flaws in executive pay and why the pay-setting process has been inconsistent with the traditional contract theory. For more details see Bebchuk and Fried (2004).

managers usually enjoy a great reputation inside as well as outside of the company which could be very beneficial for the members of the board. As a result, there is no bargaining at arm's length over executive compensation and no RPE as it might negatively affect a CEO awards when peer performance rise. Hence, the managerial power theory predicts a positive correlation between the manager's power and excessive pay.[33] Bertrand and Mullainathan (2001), Garvey and Milbourn (2006) and Bell and Van Reenen (2016) find empirical support for this case.

Bertrand and Mullainathan (2001) investigate whether common shocks, which they label as "luck", are taken into consideration in evaluating the performance of the CEO. They use several measures of "luck" and show that CEO compensation in the oil industry reciprocates as much to a lucky dollar as to a general dollar.[34] In other words, CEO pay is tied to the "lucky", systematic part of firm performance that has nothing to do with his effort. This result seems to be more prominent in firms with weaker corporate governance structure.[35] In addition, sensitivity of pay to luck is stronger when shareholders are diffuse and more passive. The last two points indicate that CEOs who are under weaker control have a greater influence over their pay, consistent with the skimming model. Garvey and Milbourn (2006) complement this study. They also observe pay-for-luck in the U.S. data with 6263 observations from 1992-2001. However, they report strong empirical evidence that executives are able to get rewards coming from good luck, whereas they are isolated from bad luck.[36] They show that benchmarks used to evaluate the CEO performance are not used consistently across years. They are more prominent when they are down which is inline with the interest of managers. Consistent with the study by Bertrand and Mullainathan (2001), they find that the practice of such asymmetric benchmarking is prevalent in companies with bad corporate governance.[37] They then examine if the boards change the option-granting policies in order to protect CEOs from bad luck. In particular, they investigate two stock option granting policies: fixed-number and fixed-value granting policies. In the first one the values of grants grow with the firm value, whereas in the second one the value of the option grants is fixed and is therefore independent of the stock price. The authors then reason that firms would opt for a fixed-number granting policy when the luck is good, but would choose fixed-value option policies when the luck is bad. The empirical evidence they report support this prediction. Gopalan et al. (2010) also find evidence of asymmetric benchmarking in the sample of firms they investigate. This asymmetry seems to be more pronounced in the multi-segment firms, firms whose CEOs have a greater flexibility in making decisions about the firm's strategy, and in firms that have more talented CEOs. A more recent study also implicitly supports the managerial power hypothesis. Namely, Bell and Van Reenen (2016) examine a sam-

[33]For more details see Bebchuk and Fried (2004).

[34]The authors use movements in oil prices, changes in exchange rates, year-to-year differences in mean industry performance as measures for luck.

[35]The corporate governance is measured by the presence of large shareholders, CEO tenure (interacted with the presence of large shareholders to better proxy for entrenchment), size of the board, and the fraction of directors that are insiders.

[36]Industry stock returns at the two-digit SIC level is used as a proxy for luck.

[37]The authors use the corporate governance index developed by Gompers et al. (2003) as a proxy for corporate governance.

ple of U.K. relative long-term incentive plans in executive pay and report an asymmetric pay-performance relationship.[38] CEO pay seems to be more sensitive to increases in firm stock performance than decreases. Consistent with Bertrand and Mullainathan (2001) and Garvey and Milbourn (2006), the authors report that such relationship is more prevalent in firms with weak governance structures. They also report that despite the presence of relative long-term incentive plans, the CEO seems to be compensated for "luck". It seems that these schemes have weak effect on reducing pay for luck in compensation contracts.

To sum up, the absence of RPE seems to be more prevalent in firms with weaker governance structure. Such firms offer more space for executive to exercise their power and influence the level of their pay. Moreover, the asymmetric performance benchmarking is also dominant in such firms. If CEO can influence his pay, he would rather have his performance evaluated against a falling benchmark.

## 1.3.5 Other Possible Explanations

### 1.3.5.1 RPE and strategic flexibility

Gopalan et al. (2010) find that a managerial flexibility in determining a firm's strategy might make RPE compensation contracts suboptimal.

Traditional principal-agent model assumes that sector performance is a noisy part of the firm performance over which the CEO has no control. Thus, the board should be interested in unsystematic firm performance which is within the CEO power and a result of his effort. However, Gopalan et al. (2010) contend that a board should also consider whether the CEO has the right foresight of the firm's strategy when evaluating a CEO performance. When a CEO makes investment and strategical firm decisions, he might want to affect the firm's exposure to its sector performance and should be concerned how well the firm fits into it (Gopalan et al. 2010). As a consequence, Gopalan et al. (2010) argue that CEOs should be compensated for peer performance. Indeed, the model introduced by Gopalan et al. (2010) supports this argumentation. Put it other way, they show that presence of RPE in compensation contract is suboptimal if sector performance impacts firm performance. In addition, the model predicts that pay for sector performance (no RPE) is more likely in the multi-segment firms, firms that offer larger flexibility to their CEOs to change the firm's exposure to the sector performance, and in the firms with the more talented CEOs.[39] The empirical results support all these theoretical predictions. Namely, the authors use U.S data from 1992-2006, where the proxy for sector performance is represented by industry returns. The authors argue that a CEO can alter exposure of his firm to the sector by altering the exercise timing of the growth options (Gopalan et al. 2010, p.2064). Hence, the authors use market-to-book ratio at the industry level, and industry research and development (R&D) expenses as proxies for strategic flexibility (Gopalan et al. 2010, p.2064). Indeed, the empirical results support the theoretical prediction – pay for sector performance appears to be more prevalent in the firms and industries offering greater strategic flexibility to the management. This result is justified by the fact that such

[38]The sample in the study consists of 472 large publicly listed UK firms each year from 1999 to 2014.

[39]The results of the study with respect to the CEO talent are outlined in Section 1.3.1.

firms provide bigger chance for the manager to "shift resources to the sectors expected to outperform" (Gopalan et al. 2010, p.2063).

Briefly, no RPE in executive compensation contract might be optimal when the CEO pay serves as a device that offers strategic incentives to the CEO.

#### 1.3.5.2 RPE model specifications

Alanis (2015) calls for a new metric for firm performance and argues that many studies failed to detect RPE because they used unsatisfactory firm performance measure. The author argues that executives hold significant amount of inside debt implying that firm performance measures should capture this variable as well (Alanis 2015, p.3). Hence, he calls for the use of total firm return metric which includes equity returns and return on the firm's debt in testing RPE. He uses two methods to determine total return metric. First, Alanis (2015) employs a model of firm value introduced by Merton (1974) and by means of calibration procedure estimates the total return.[40] Second, as the above mentioned method does not reflect true market information (and it is sensitive to the calibration parameters), the author uses actual bond prices acquired from the Trade Reporting and Compliance Engine (TRACE) database in order to calculate market prices for a firm's debt. On the sample of U.S firms from 1992 to 2012, the author tests the RPE use and employs battery of firm performance measures: equity returns, total return based on the method developed by Merton (1974) and total return based on the market prices of firm's debt.[41] He detects stronger use of RPE when employing his measure of firm performance. In addition, the evidence is in line with the strong-form RPE version in the models where total returns are utlilzed. This result seems to be robust to several other potential issues.[42]

Angelis and Grinstein (2016) argue that the CEO contracts with RPE in practice have non-linear form and that the linear empirical specification of RPE used in the academic literature does not reflect the reality. Consequently, they contend that this might be a reason for the inconclusive results regarding RPE. Therefore, they introduce a new measure for peer performance that is meant to capture this non-linearity – peer performance measure based on the rank performance of an executive to his peers (Angelis and Grinstein 2016, p.3). In particular, they propose "the cumulative distribution function (CDF) of total shareholder return (TSR) relative to the TSR of firms in the same 2-digit SIC industry code" (Angelis and Grinstein 2016, p.23). They expect the coefficient on this variable to be positive as RPE is determined in a rank-based fashion. In addition to TSR, they include return on assets (ROA) as absolute measure of firm performance.[43] They find evidence consistent with RPE in the sample of 18014 firm-year CEO pay observations over 1992-2005. Namely, Angelis and Grinstein (2016, p.25) report 1% increase in the rank of the CEO performance relative to the industry leads to 0.14% increase in CEO pay. Moreover,

[40] According to Merton (1974) a firm's equity value can be regraded as its call option on its assets. The exercise price is equal to the firm's debt.

[41] The sample consists of 24207 firm-year observations for 2525 firms and 4774 different CEOs.

[42] Alanis (2015) repeats the same regression procedures at the firm level and on different industry specifications and weighting schemes.

[43] Consistent with previous studies, they control for the firm size, CEO tenure and for the CEO-firm and year fixed effects.

their empirical specification seems to have a slightly better explanatory power than the traditional empirical specification with industry performance. In an additional test, the authors include both traditional RPE and rank-based specification in the empirical model. The empirical evidence reveals that measure of peer performance in the traditional specification – industry TSR – is insignificant. This is not the case for the coefficient of CDF of TSR relative to the TSR of firms in the same industry. The coefficient is statistically significant but also similar in magnitude to the coefficient in previously mentioned specification. As noted by Angelis and Grinstein (2016, p.25), this might indicate that the CDF is better able to seize the variation in pay in comparison to the industry return.

## 1.4 Relative Performance Evaluation and Firm Characteristics

This section examines how the use of RPE varies with different firm characteristics.

### 1.4.1 RPE and common uncertainty

Kren (2002) hypothesize that the likelihood of RPE use is positively related to the common uncertainty faced by both firm and peers.[44] In oder to proxy for common uncertainty Kren (2002) introduces two variables in a sample of 2410 firm-year observations over 1985-1994. The first one is adopted from Tosi et al. (1973) and is based on accounting measures. This measure for the uncertainty combines proxies for market, technological and income volatility (Kren 2002, p.123). These three measures are then aggregated for each firm and each industry. Kren (2002) then calculates correlation between each firm's uncertainty measure and the mean of the four-digit SIC industry uncertainty measure over ten year period. This represents the first measure of the common uncertainty. The second measure is represented by correlation between firm's common stock return and the mean industry stock return on the monthly basis (Kren 2002, p.124). In order to test the hypothesis, the author first conducts a traditional implicit test of RPE for each firm in the sample. In the second step, the estimated coefficient on industry performance is regressed on the measure of common uncertainty and a vector of control variables.[45] The author then predicts that the coefficient on the common uncertainty will be negative, should his hypothesis hold.[46] Indeed, the data shows that in the presence of higher uncertainty, the CEO pay seems to be better filtered from industry exogenous shocks. This, however, holds only when the common uncertainty is proxied by the Kren's second proxy based on stock returns. Consistent with this finding, Gong et al. (2011) also document that firms that are exposed to common risk have a greater tendency to use RPE.

[44] This is a theoretical prediction that goes back to Holmstrom (1982) who shows that risk-sharing benefits of RPE are increasing with the common risk that affects both firm and peers.

[45] Firm's financial leverage, free cash flow, firm growth, market share, CEO tenure and industry dummies are used as control variables.

[46] Since negative (and statistically significant) coefficient on industry performance indicates a presence of RPE and the measure of common uncertainty is a positive number, a negative coefficient on common uncertainty demonstrates support for his hypothesis.

Carter et al. (2009) use annual reports of FTSE 350 firms in 2002 and investigate the use of RPE at the firm- and compensation plan-level in the performance-vested equity grants in the U.K.[47] In order to examine determinants of the RPE use in equity grants, the authors estimate multinominal logit model. For an examination of the RPE use *at the firm level*, they employ a thrichotomous variable that denotes if all, some or none of the performance-vested equity grants are based on RPE as a dependent variable (Carter et al. 2009, p.288). The authors then estimate the same empirical model with a battery of different dependent variables *at the equity plan level* in order to examine the pay-out characteristics of these equity grants. These variables reflect the features of the equity plans and their corresponding performance conditions. They are: a dummy variable equal to one if the plan comprises a payout hurdle and zero if it embraces a payout range, the minimum peer group percentile ranking for vesting to start, and the difference between the peer group percentile rankings necessary for minimum and absolute vesting to take place (Carter et al. 2009, p.279). In addition, they incorporate a dummy variable equal to one if the firm employs already existent index as a peer group, and zero if the firm self-selects peers in the equity plans (Carter et al. 2009, p.281). In order to examine the drivers of the RPE use in the equity plans the authors include a set of independent variables in their estimation model.[48] For our interest here the variable proxying for common risk is relevant. Carter et al. (2009) proxy for common risk is represented by the interaction term between the measure of volatility, and correlation between firm and peer returns. The first variable is measured as a standard deviation of monthly stock returns over the 24 months, while the second one is a firm's $\beta$.[49] Both variables are then rescaled to range from 0 to 1. Contrary to the expectations, they find little evidence that common risk drives the RPE use in performance-vested equity grants. There is some evidence that when common risk is excessive, the likelihood that the firms will use RPE in all of their equity grants is decreasing. On the other hand, the common risk seems to be related to the specific relative performance conditions in the equity plans. Namely, they find that common risk drives the use of hurdles in the equity grants, suggesting that "firms facing greater common risk tend to use relative performance hurdles to remove common shocks from performance evaluations, rather than requiring executives to achieve significantly higher performance rankings relative to competitors to receive full vesting" (Carter et al. 2009, p.290). In addition, common risk induces the use of relative percentile ranking for minimum vesting in equity plans.

### 1.4.2 Growth Options and RPE

Albuquerque (2014) examines how the use of RPE varies with the level of growth options. In order to capture the level of growth options in firms, she uses market-to-book ratio and ratio of research and development (R&D) costs to assets (Albuquerque 2014, p.28). The study then estimates the pooled cross-sectional, time-series regression model on a sample

[47] In these type of grants vesting of a grant is related to the performance targets which are determined relative to a peer group performance. In this study the authors examine 145 RPE plans in 129 firms.

[48] For more details on all the independent variables, see p.281-285 in Carter et al. (2009).

[49] The firm's $\beta$ is acquired in the regression of firm returns on the peer returns, where peer returns are proxied by FTSE 350 index and FTSE industry returns.

of 15557 observations in 1995-2008.[50] In particular, Albuquerque (2014) uses regression of the CEO pay against the firm and peer performance measures, the interaction term between firm performance and growth options, and the interaction term between peer performance and growth options.[51] In the first test, the variable of interests is the interaction term between the peer performance and growth options. It is expected to be positive if growth option firms refrain from the use of peer groups in the RPE test. Such result would then support argumentation that the RPE use incurs greater costs to the benefits for the high growth option firms (Albuquerque 2014). Indeed, empirical results confirm this expectation. Albuquerque (2014) puts forward the view that such evidence might well be a consequence of high growth option firms facing a difficulty in identifying an appropriate peer group that would seize the common risk exposure appropriately. She notes that high growth option firms "expect to earn future abnormal economic rents through the existence of firm-specific know-how, barriers to entry, or other proprietary information (e.g. patents) that is not available to other firms" (Albuquerque 2014, p.28). Consequently, the implementation of RPE is too costly due to the difficulty in identifying the peer group for high growth options firms. In the second test, the author then analyzes a sample of 750 firms from 2006 to 2008 and finds that the likelihood that a firm will disclose the RPE use decreases with the level of growth options. Moreover, the high-growth option firms that use RPE in compensating their executives use less number of peers when constructing a peer group. In analyzing RPE use at the industry level, the study reports that industries such as utility, financial and energy industries (low growth options industries) have a greater tendency to use RPE. On the contrary, this does not hold for high-growth option industries such as health care, information technology, confirming previously presented results – RPE in CEO pay in negatively related to the level of growth options. The study by Gong et al. (2011) dovetails these results.

### 1.4.3 RPE and R&D Costs

Keune (2015) investigates if the use of performance-vesting, long-term RPE incentives is related to the under-investment in research and development (R&D). Precisely, the author wants to shed light on whether compensation committees monitor the risk of under-investment in R&D and correspond to such risks by awarding the long-term RPE incentives to their executives in order to mitigate such risks. The author expects that compensation committees facilitate long-term RPE incentives when CEOs are more likely to under-invest in R&D.

For the sake of testing these hypothesises, the author gathers data on S&P 500 companies that contain 3024 firm-year observations over 1995-2009. In order to answer his research question, he conducts two empirical tests. Keune (2015) first calculates the measure for the under-investment in R&D. Precisely, he calculates the so-called "differences from expected R&D investment" which are represented by the residuals from the OLS estimation of R&D costs scaled by lagged total assets on sales growth. Keune (2015,

[50] The sample consists of 3885 executives and 2457 firms.

[51] In addition, the author also employs a battery of control variables. For more details, see p.32 in Albuquerque (2014).

p.18-19) then ranks this variable and constructs a dummy that equals 1 if the measure lies in the bottom quartile. The dummy is equal zero otherwise (Keune 2015, p.18-19). He assumes that companies with the measure equal to 1 are more likely to invest less in R&D as they are more financially constrained. He conducts a logistic regression, where the dependent variable is this dummy that captures the under-investment in R&D. The independent variables include: an indicator variable for performance-vesting, long-term RPE incentives, investment, governance, and compensation control variables.[52] In the second test the author uses the OLS regression model of R&D costs scaled by lagged total assets against the set of independent variables. The independent variables include an indicator variable for the RPE incentives, a measure for likelihood of under-investment in R&D, an interaction term between RPE incentives and the measure for likelihood of under-investment in R&D and a battery of control variables.[53]

As predicted, the author reports that the performance-vested, long term RPE incentives are negatively related with the under-investment in R&D as one part of the strategic investment. This effect develops gradually over time. He finds that firms with the risk of under-investment offer their CEOs more performance-vested long-term RPE incentives. In other words, the probability that compensation committees offer such incentives to the CEO is higher in firms with low cash balance, in which R&D costs have decreased over years, and in firms in which R&D is less than industry peers over the years. In similar manner, Liu (2008) investigates if there is an association between R&D costs and the use of RPE in cash compensation of board of directors in the U.K. They test for strong-from RPE tests in the panel sample of 586 UK non-financial public listed firms from 1990 to 1998. Namely, they test RPE on two subsamples – high R&D cost firms and low R&D firms. The presented evidence is inconclusive. Liu (2008) documents a weaker relation between the accounting-based RPE use in cash compensation in R&D intensive firms in comparison to the low intensive R&D firms. However, it seems that both intensive and low R&D firms entertain RPE use in compensating their directors, when the market-based firm performance measure is employed.

### 1.4.4 RPE and IFRS

Ozkan et al. (2012) investigate how the adoption of International Financial Reporting Standards (IFRS) impacts the executive compensation contracts. Precisely, the authors are interested in how this regulation change affects the use of accounting-based RPE and the overall pay-performance sensitivity in executive compensation contracts. The authors expect that if compensation committees perceive the accounting information to be improved by the regulation, they will tend to increase the use of accounting earnings as a measure of firm performance in executive contracts. This would then positively impact pay-performance sensitivity. In similar manner, due to increased comparability of different accounting standards across countries the authors expect a greater use of foreign peers

[52] For more details on this model, the independent and control variables see p.19-21 in Keune (2015).

[53] A measure for likelihood of under-investment in R&D is calculated as "the average of the ranking of cash and the ranking of negative one multiplied by leverage" (Keune 2015, p.16). Keune (2015, p.16) again creates a dummy equal to one if the measure lies in the bottom quartile, and zero otherwise.

in accounting-based RPE. This would then open the door for greater use of accounting-based RPE. Such insight provides useful information on how compensation committees of the European companies perceive the new regulation (Ozkan et al. 2012).

To examine the issue under scrutiny Ozkan et al. (2012) employ a sample of 892 public companies from 15 central European countries that adopted IFRS in 2005.[54] In order to investigate whether the new regulation made accounting information more prevalent as firm performance proxy, the authors estimate the change in the natural logarithm of executive pay on several independent variables. These variables are: change of pre-tax income divided by total assets (accounting firm performance), the indicator variable *Post* that captures pre- and post-regulation period, the cumulative stock return (market-based performance), the interaction term between the market-based performance and the *Post* variable, and the interaction term between the *Post* variable and accounting-based firm performance.[55] The variable of interest is the coefficient on the interaction term between the accounting performance and the variable *Post*. Given their hypothesis, the authors expect this variable to be positive and statistically significant.

The authors also predict that there is a change in the use of RPE based on accounting performance after the new regulation has been adopted. In order to test this, Ozkan et al. (2012) utilize the same empirical model mentioned above but add proxies for peer performance, and the interaction terms between these peer measures and the *Post* variable. The interaction terms are included in order to estimate the effect of the new regulation change on the RPE use. Peers are chosen based on similarity of firm size to the size of the target company within the same three-digit SIC industry code. As in the RPE tests, the coefficient on the interaction term is expected to be negative and statistically significant. Finally, in another test Ozkan et al. (2012) examine whether companies tend to use more foreign peers for performance benchmarking. In the empirical model, they differentiate between domestic and foreign peers when building a peer group. In particular, they add peer performance measures based on domestic peers and foreign peers respectively, and the interaction term of these variables with the variable *Post* in the empirical specification (in order to control for the IFRS regulation change). Thus, they predict a statistically significant and negative coefficient on the interaction term between the *Post* variable and accounting-based foreign peer performance.

Consistent with expectation, Ozkan et al. (2012) report that compensation committees increased the use of accounting measures in compensation contracts after IFRS came into force, leading to the higher pay-performance sensitivity. This effect seems to be facilitated by the countries exhibiting discrepancies between IFRS and local accounting standards. Moreover, foreign peers appear to have a greater use in constructing peer performance after 2005. In addition, firms with more foreign operations and those with fewer comparable domestic peers seem to entertain a greater use of accounting RPE in determining level of executive pay.

[54]The full sample covers 1505 CEO-year observations for 3046 firm-years.

[55]The *Post* variable equals one for years 2006-2008 and 0 for years 2002-2004. The authors also control for market-to-book ratio, firm size, CEO fixed effects, CEO age and include a dummy variable that equals 1 if executive has been in that position for less than two years. In addition, the authors include year and country fixed effects.

### 1.4.5 RPE and other firm characteristics

In their attempt to examine firm's decisions to use RPE, Gong et al. (2011) employ multivariate logistic regression where the dependent variable is an indicator variable equal to 1 if the firm uses RPE in at least one component of the total executive pay. They use several firm and CEO characteristics to determine which one of them drives the RPE use.[56] This test reveals several important findings (Gong et al. 2011, p.1025-1027). The evidence suggests that the less concentrated industries have a greater tendency to benchmark the performance of the CEO against the peer group. They clarify this as a result of the higher risk that firms in competitive industries face. Moreover, firm size also drives the use of RPE in executive compensation findings which dovetails the results of the previous studies. The amount of the CEO equity holdings also seem to play a role in determining the RPE use (Gong et al. 2011, p.1025-1027). There is a negative relation between the RPE use and large CEO equity holdings. Corporate governance, as expected by the authors, plays a role in determining RPE tests – firms with more independent boards seem to entertain the RPE use in greater extent (Gong et al. 2011, p.1025-1027). Finally the presence of compensation consultants also enhances the RPE use (Gong et al. 2011, p.1025-1027).

### 1.4.6 RPE effects

Tice (2015) investigates the effects of RPE use on managerial investment decisions and firm performance. The author expects that RPE firms are less prone to the under- or over-investing in the presence of RPE compensation contracts as such contracts, according to the theory, should optimally set managerial incentives (Tice 2015, p.3).

On this account, Tice (2015) employs propensity score matching in order to match firms on determinants of RPE use. Hence, she ends up with a matched sample of RPE firms that represent a treatment group, and a group of non-RPE firms representing a control group.[57] In order to proxy for investment efficiency, Tice (2015) uses residuals from the estimation model of total investment on investment decisions determinants – sales growth, leverage, level of cash, firm age, and firm size.[58] The author then argues that residuals from this estimation model contain information about firm's deviation from expected investment, and therefore groups firms based on the size of the residuals. Tice (2015, p.24) denotes firms with residuals in the highest quartile as over-investing, and those with residuals in the lowest quartile as under-investing. Firms whose residuals are in the middle quartile are denoted as the benchmark group. In order to investigate how the RPE affects investment efficiency, she uses a multinominal logistic model where the dependent variable is 0 for the benchmark group, 1 for the firms that are under-investing and 2 for the firms that are over-investing. In the set of control variables, she includes a dummy variable equal to 1 when firms report the use of RPE in the CEO pay, and 0 otherwise in order to examine how the RPE use affects the likelihood that a firm will over-

[56] For more details on how these variables are constructed see p. 1023-1025 in Gong et al. (2011).

[57] RPE sample contains 1812 firm-year observations, whereas non-RPE sample consists of 2030 firm-year observations.

[58] Tice (2015, p.24) defines total investment as the sum of capital expenditures, acquisitions, and R&D costs minus the sale of property, plant, and equipment.

or under-invest.[59] In similar fashion, the effect of RPE in firm performance is examined. Namely, the author estimates the regression model where the firm performance, proxied by total shareholder return, is a function of a RPE use and a set of other control variables.

Results indicate that RPE presence in compensation contracts indeed enhances the managerial investment decision behaviour. Namely, Tice (2015) finds that RPE firms are less likely to under-or over-invest, which is consistent with the initial expectation. Interestingly, results suggest that the RPE use in executive pay impels the investment efficiency improvement in firms that do not entertain the RPE use. With regard to the effect of RPE on firm performance, the results are inconclusive. Tice (2015) documents some evidence that RPE firms that use total shareholder return perform better than non-RPE firms. However, this does not hold in general for the whole sample. Matsumura and Shin (2006) also provide some piece of evidence on the effect of RPE on firm performance. Namely, they examine incentive plans of all employees of the 214 postal stores in Korea from 1997-1999 and report that financial performance improved after the implementation of RPE in compensation schemes in 1998.[60] Moreover, they report a positive correlation between a store's degree of common uncertainty and its profitability, when the RPE compensation scheme is entertained. These findings propose that firms facing higher level of common uncertainty with RPE compensation plan might motivate managers to increase their effort, which is followed by a better financial performance.

## 1.5 Relative Performance Evaluation and CEO Turnover

### 1.5.1 Do boards filter out exogenous shocks when deciding to retain a CEO or not?

A CEO turnover represents a departure of one CEO and the ascension of another. The conditions on which an executive is being dismissed is an important element of the executive contract (Gibbons and Murphy 1990). As such, it provides significant insights about governance policy in every firm. By dismissing a CEO a firm hinders costs that might be caused by his incompetency (Gibbons and Murphy 1990, p.26). However, if his performance is not evaluated in appropriate manner, the CEO departure might incur even higher costs to the shareholders. That is, the costs of the valuable human capital loss related to the CEO education and skills (Gibbons and Murphy 1990, p.26).

In the context of CEO turnover, RPE implies that boards consider CEO's performance relative to a peer group when deciding whether to keep him or not. If this is not the case, the CEO is then exposed to common risk, which introduces uncertainty into his contract (Gibbons and Murphy 1990). Researchers typically estimate logistic regression where an indicator variable, equal to one in the year of the CEO departure (the year when a CEO leaves the office) and zero otherwise, is a function of firm and peer performance in order to determine the effect of firm and peer performance on the probability that a CEO

[59] In addition, she employs a set of other control variables. For more details, see p.24 in Tice (2015).

[60] The authors examine the incentive plans of all employees, including executives.

is about to leave the office.[61] According to the RPE theory, a CEO is more (less) likely to be fired following bad (good) firm performance (negative and statistically significant coefficient on firm performance) but is less (more) likely to leave following bad (good) years in the peer return (positive and statistically significant coefficient on peer returns).

Against this background, Warner et al. (1988) investigate 87 CEO turnovers in the sample from 1963 to 1978 and report that CEO turnover is negatively related to the firm and positively to the market return, which is inline with the theory.[62] However, the evidence is inconclusive when the industry returns are applied as a measure of peer performance. They find that common industry shocks are not removed from the CEO dismissals when using lagged returns. In addition, CEO turnover is not sensitive to industry peers after controlling for market return. Similarly, Gibbons and Murphy (1990) find that over half of their CEOs left the office during their sample period and examine whether and how this turnover is related to the firm and peer performance measures. They use battery of different peer performance measures: market returns, and one-, two-, three-, four-digit industry returns and report that turnover probabilities are negatively and significantly related to the firm return, and positively and significantly with the peer return. However, in line with their findings with regard to executive pay, they report that the coefficient on industry return declines with the narrowness of industry definition. Therefore, CEO turnover seems to be more sensitive to market shocks. Barro and Barro (1990) estimate the logit regression in order to examine how the probability of CEO departure relates to the CEO age, absolute and relative performance, and market-based versus accounting-based measures in the banking industry. As expected the probability of CEO turnover increases with the CEO age, and tends to be the highest when the CEO is around 65 years old. That comes as no surprise given that this is the average retirement age. On the other hand, the probability of dismissal declines for the CEOs of age 52 or younger. However, across all age groups the probability of a CEO dismissal is a declining function of a better stock performance. Unlike with the growth of compensation, Barro and Barro (1990) document that CEO dismissal is sensitive to the regional performance indicating that decisions about the CEO turnover involve peer comparisons.[63] Yet, they find evidence inconsistent with RPE use in CEO dismissal decisions when accounting-based measures are employed. Barro and Barro (1990, p.477) interpret this as a result of accounting returns being more prone to short-term manipulation coming from the CEO. For example, if a CEO is aware that he is about to be dismissed, his incentive to manipulate accounting earnings over the short horizon increases (Barro and Barro 1990, p.477).[64]

Blackwell et al. (1994) focus on the lower-ranked managers who are in charge of subunits within the firm. They investigate the relationship between accounting-based performance and decisions over their turnover and promotion. For this purpose, they employ

[61] This is a weak-form version of RPE. The same distinction between different types of RPE mentioned in the Section 1.2 applies in the context of CEO turnovers.

[62] Even though Morck et al. (1989), Weisbach (1988) and Jensen and Murphy (1990) do not explicitly test RPE in CEO turnover decisions, they provide some implicit empirical evidence on this case.

[63] Moreover, the CEO dismissal is also a sensitive to relative stock performance measure calculated as a difference of absolute firm and regional performance measures.

[64] More details on the data used in Barro and Barro (1990), Gibbons and Murphy (1990) and Jensen and Murphy (1990) are presented in Section 1.2.

a sample of managers of subsidiaries of Texas bank holding companies from 1984-1987. The authors examine whether the CEOs are dismissed based on their relative performance and if promotions within the firm are sensitive to accounting performance. As a performance measure, the authors employ return on assets (ROA) after tax and extraordinary items. Peer performance is set twofold: ROA for median bank within the same holding company and ROA for median bank in the same region. The empirical results generally support the relative-performance evaluation – the coefficient on the peer performance is positive and statistically significant, whereas the coefficient on the absolute firm performance measure is negative and statistically significant when the first proxy for peer performance is employed. This, however, does not hold when peers are set at the regional level. Blackwell et al. (1994) explain that this might well be a results of very low correlation between the ROA for the median bank in the region and individual bank performance. Finally, it seems that firm's decision to promote internally rather than externally is (positively) sensitive to the performance of a subsidiary bank. Based on these finding the authors conclude that firings and promotions are indeed represent a motivational mechanism for the lower-level mangers.[65]

The study by Chen et al. (2005) refrains from managerial turnovers and investigates turnovers of Chinese provincial leaders. Precisely, the authors investigate whether the Chinese government makes decisions about the dismissal of provincial leaders based on provincial economic performance relative to their predecessors' performance. The authors employ the sample of 344 provincial leaders from 28 Chinese provinces over 1979-2002. In evaluating whether leaders are being dismissed based on relative performance, Chen et al. (2005) set moving average of provincial GDP growth rates over provincial leaders' tenure as a performance metric. Peer performance metrics are proxied by the average GDP growth rate of immediate predecessor and the average GDP growth of neighbouring provinces. They then estimate the ordered probit model and report that the Chinese central government uses relative performance evaluation in making decisions about the turnover of the provincial leaders.[66] However, the Chinese central government seems to benchmark the performance only against the immediate predecessor, but not against neighbouring provinces.

Perviously mentioned studies find evidence consistent with hypothesis that exogenous shocks are filtered from the performance of the manager when decision about his dismissal is made at the top, but also at the lower managerial level. These studies employ a weak-form tests of RPE which imply that *some* but not *all* the shocks are removed from the performance evaluation of the CEO. Jenter and Kanaan (2015) plunge deeper in the subject and employ strong-form tests of RPE and come across intriguing findings.

[65]The study by Cichello et al. (2009) supports these results. In similar manner, Cichello et al. (2009) examine turnover of division managers in multidivisional firms in the U.S. on the sample of 1294 observations from 1993-2000. Consistent with RPE, turnover of a divisional manager is positively associated with the industry performance but not to the firm performance or other divisions' performance. Overall, the study suggests that accounting information seems to be a useful metric in evaluating the performance of divisional managers and that divisional managers are provided with considerable incentives to increase performance of their division.

[66]The authors control for provincial leaders' characteristics such as working experience within the government, age and education.

They examine a sample of 3042 U.S. firms and 3365 CEO turnover decisions over 1993-2009 and report very weak evidence that boards partially remove industry and market performance from the performance evaluation in CEO dismissal decisions.[67] When they turn to the strong-form RPE tests, the evidence suggests that CEOs are more likely to be dismissed after the negative peer performance, which does not lend support to the RPE. Digging deeper, the authors find that the likelihood of a forced CEO departure doubles as the systematic component of firm performance declines from 90th to its 10th percentile.[68] They then further report that this negative effect is prevalent in groups of CEOs who underperform the industry. There seems to be no influence of peer performance on CEOs who outperform their industry peers. Based on these results the authors conclude "that the peer performance effect on CEO turnovers is driven by boards removing many more underperforming (but not outperforming) CEOs in bad times than in good times" (Jenter and Kanaan 2015, p.2177). Underperformance of CEOs in recessions is not well-regarded by the board about the CEO's quality. This typically causes the forced CEO turnover. In addition, it seems that filtering of shocks is stronger when the value-weighted industry performance is used in comparison to the equal-weighted peer performance. This might suggest that boards evaluate the CEO performance against more "precise" benchmark (Jenter and Kanaan 2015). The study by Barakova and Palvia (2010) goes in line with the findings presented in Jenter and Kanaan (2015). Strengthening the results by Jenter and Kanaan (2015), they report that the probability of CEO dismissal in the U.S. in a small, commercial, mostly private banks increases with the bad industry accounting performance from 1985-1994.[69] Barakova and Palvia (2010, p.224) build a regulatory rating of bank management as a proxy for corporate governance in order to examine how this result is related to the corporate governance.[70] They then report that this result is more pronounced at better-governed banks, which the authors interpret as a signal that less RPE in not necessarily facilitated by bad governance structure. On the contrary, they argue that "bad times allow for better identification of management quality" (Barakova and Palvia 2010, p.216). This leads to greater number of CEO dismissals. Consistent with Barakova and Palvia (2010) and Jenter and Kanaan (2015), Gopalan et al. (2010) find that the probability of a disciplinary turnover is decreasing with sector performance.[71] They report that this effect is stronger in industries with high market-to-book ratios and intensive R&D costs – industries that offer higher flexibility for the CEO to choose firm's strategy.

[67] The sample consists of 2490 voluntary and 875 forced CEO turnovers.

[68] Systematic component of firm performance is set as industry component of firm performance.

[69] The sample with 18944 bank-year observations consists of banks with assets of USD100 million or less.

[70] Barakova and Palvia (2010, p.223) define the rating as a "summary measure of regulatory opinion of management competence, leadership, administration ability, planning ability, depth and succession, and self-dealing tendencies." It might take a value from 1 (best) to 5 (worst).

[71] Disciplinary turnover is defined as any departure of CEO which is caused by his dismissal, forced dismissal or unspecified differences in corporate policy. This definition is adopted by Parrino (1997).

### 1.5.2 Relative Performance Evaluation and CEO Turnover around IFRS

Wu and Zhang (2010) examine how the mandatory International Financial Reporting Standards (IFRS) affect financial reporting comparability, and consequently the use of RPE in the context of CEO turnover decisions. In particular, they want to reveal empirical evidence on whether better accounting comparability after IFRS adoption improves the RPE use in CEO retention decisions.

Their sample consists of Continental European firms from 1993-2006.[72] They employ the logit model where the dependent variable, equal to one in the year of the CEO dismissal, is a function of the lagged return on assets and lagged raw stock return before the IFRS adoption respectively, lagged return on assets and lagged raw stock return after the IFRS adoption, and corresponding peer performance measures before and after the IFRS change.[73] Peer group measures in this paper are determined twofold. First, they are proxied by an indicator variable equal to one if the median peer group performance is greater than the firm's own performance. Second, in an alternative specification Wu and Zhang (2010) use continuous peer performance measures. They differentiate between the foreign peer performance based on domestic accounting standards and foreign peer performance based on IFRS. The foreign peer group consists of firms that belong to the same 2-digit SIC industry but different country (Wu and Zhang 2010). The authors then expect a positive and statistically significant coefficient on the peer performance measures should the effect of common shocks be removed from decisions regarding the CEO turnover.

The authors first conduct RPE tests on the foreign peer group performance based on domestic accounting standards in years 1993-2005, before the IFRS adoption. They then compare these results with those after 2005 when the foreign peer group is aggregated following IFRS. They find strong empirical evidence consistent with accounting-based RPE after the IFRS adoption when the peer group is aggregated based on the foreign peers. On the contrary, they find no such evidence before the adoption. In addition, consistent with previous studies, the authors document that CEO turnover is negatively associated to a firm's own accounting and stock performance. The authors argue that these results are a consequence of a better financial reporting comparability with foreign peers or more precise peer performance measures after the IFRS has taken place which is consistent with findings presented in Ozkan et al. (2012).

### 1.5.3 RPE Model Specifications in CEO Turnover

The study by Fee et al. (2015) tries to shed light on two questions. First, the study investigates the role of modelling choices in drawing empirical inferences on the use of RPE in the CEO turnover decisions. The authors argue that this would offer researchers guidance on how to appropriately conduct the RPE tests in the context of CEO departure. Second, it examines the robustness of previous studies conducted on the relation between

[72] They argue that these firms are particularly suitable for testing the RPE as they encounter similar exogenous shocks.

[73] In addition, the authors control for firm size, leverage, book-to-market value, country, year and industry dummies.

CEO turnover and firm performance, and CEO turnover and industry performance. In this manner, they want to strengthen out whether the findings of the previous studies are resilient. For this purpose, they employ a sample of Compustat firms that consists of 60816 firm-years observations from 1991-2007.[74] They report that the way the turnover is specified and how the stock performance metric is calculated significantly affects the RPE tests. To that end, they suggest that every researcher should check the robustness of his results on the liberal and conservative measure of the CEO turnover. By the liberal definition, they refer to all the CEO departures that are not caused by the health, death, acquisitions or jump events (Fee et al. 2015, p.15). They argue that many studies treat some of the CEO departures as a voluntary which does not correspond to the reality. This yet affects the number of observations of the dependent variable in the regression models. Consequently, this alters the inferences made about RPE in CEO turnover decisions. In addition, they recommend that the results should be robust to different performance metrics. Specifically, Fee et al. (2015, p.37) recommend the use of log transformed stock returns or a percentile ranking in order to capture "non-normality" of the stock return data. Moreover, they suggest the use of linear probability models instead of logit and Cox models which often tend to be sensitive to model specifications (Fee et al. 2015, p.37).

The authors then implement all the above mentioned recommendations on their sample of Compustat and compare it to the traditionally used specifications. They find that sensitivity of firm performance to CEO turnover is extremely robust across most of the model specifications. This leads to the conclusion that boards do consider firm performance when making decisions on whether to retain a CEO or not. However, this does not hold for the relation between industry performance and CEO turnover. The authors obtain evidence of such relation only under very specific model specifications. Hence, Fee et al. (2015, p.38) conclude that the widely presented finding that the industry performance affects CEO turnover might be misleading.

## 1.6 Conclusion

The empirical research has scrutinized the theoretical prediction of relative performance evaluation for more than 30 years. In this respect, we can distinguish between the studies that examine relative performance evaluation in executive pay and executive turnover decisions. Results of both of these branches provide insights relevant for both academic society and the public. To that end, this paper provides an overview of the state of the academic literature on relative performance evaluation.

A comprehensive overview of the RPE literature in the context of executive pay has brought inconclusive evidence. Yet, the academic literature offers several explanations for this case. First, in the light of booming markets compensating manager based on the constantly rising peer performance benchmark might not be optimal if the CEO talent on the market is scarce. As the demand for the CEO skill is high, shareholders might lose manager who has an incentive to leave if the other firms on the market offer a compensa-

[74]They use all Compustat firms except for utilities, financials, foreign firms, firms with less than USD 10 million in assets and firms that are not listed in the Compustat name file.

tion contract without RPE provision. In this situation RPE might not be optimal for the shareholders. When the CEO is older and more wealthy, he is able to hedge the market risk on his private account. Hence, we find no RPE in their compensation contracts. Second, peer group construction plays important role in detecting RPE in CEO pay. Industry and market indices have shown not to perform well when it comes to capturing exogenous shocks on the market. This introduces bias in the empirical tests. For this purpose, product-market, industry/size or self-selected peers are more suitable. Third, empirical tests of RPE often neglect strategic interactions between firms. Absence of RPE in competitive environment might be optimal as it offsets managerial collusive behavior, that might undermine shareholder returns. Fourth, managers might exert their influence over the board in order to set the pay that fits their interests the most. Hence, in this case we observe no RPE when that is not in executive interests. Fifth, in a situation when a CEO determines firm's exposure to the sector performance in making decisions related to the firm's strategy, the manager should be compensated based on the sector performance. In this case, RPE contract is not optimal. Finally, performance metrics affect inferences about RPE tests.

RPE in executive pay seems to be more prevalent when common risk faced by the firm and its peers is high. This is consistent with the optimal contract theory. The high growth option firms seem to entertain the use of RPE to a lesser extent than the low growth firms. Such firms might find it hard to identify an appropriate peer group that captures the exposure to common risk. On the other hand, firm size seems to drive the use of RPE. Firms that face a risk of under-investment in R&D are more prone to the RPE use. This sets the right incentives for the CEO to mitigate risks of under-investment. In addition, the amount of equity holdings held by the CEO is negatively related to the RPE use at the firm level. Proxies for good corporate governance such as the greater number of independent directors and the presence of compensation consultants also seem to lead to the increased likelihood of RPE in the firms. In addition, some studies report better investment efficiency in firms that entertain the RPE use. The IFRS introduced in 2005 improves the quality of accounting information, leading to a greater use of accounting-based RPE. Finally, studies investigating the effect of RPE on firm performance seem to be inconclusive. This provides room for future research.

Studies examining whether boards remove exogenous shocks from the CEO performance when making decisions about his departure seem to be more conclusive at the first sight. In particular, the majority of the literature examining the weak-form version of the RPE in the CEO turnover seems to lend support for the RPE use. However, the studies that plunge deeper into this topic and rely on the strong-form version provide less convincing evidence of RPE in CEO departure decisions. Some evidence suggests that previous studies have been too conservative when defining a CEO turnover which affects the tests of RPE. Taken together, these studies provide important suggestions on how to improve the research design of the RPE tests in CEO turnover decisions in the future.

Overall, this paper offers an overview of important factors which affect the inferences drawn on relative performance evaluation in CEO pay and CEO turnover decisions. Inclusion of such factors in traditional econometric models of relative performance evaluation have important implications for the power of RPE tests. Therefore, they should be taken

into account in the future research on RPE.

# Chapter 2

# Preaching Water But Drinking Wine? Relative Performance Evaluation in International Banking

### Chapter Overview

Relative performance evaluation (RPE) is, at least on paper, enjoying widespread popularity in determining the level of executive compensation. Yet existing empirical evidence of RPE is decidedly mixed. Two principal explanations are held responsible for this discord. A constructional challenge arises from intricacies of identifying the correct peers. And on a simpler note, corporate commitments to RPE could be mere exercises in empty rhetoric. We address both issues and test the use of RPE in a new sample of large international non-U.S. banks. Taken as a whole, the banks in our sample show moderate evidence consistent with RPE. We report stronger evidence once we investigate the subsample of banks that disclose the use of peers in their compensation schemes. This finding lends support to the credibility and thus informational value of RPE commitments. Digging deeper, we conclude that RPE usage is driven by firm size and growth options.

## 2.1 Introduction

The rise in executive compensation in international banking in the last two decades has been striking. By the end of 2003 Citigroup, Lehman Brothers, and Bear Stearns, large players in the banking industry at that time, were run by CEOs whose earnings were among the top ten in the S&P 500 (Hodgson 2004). Two of these banks - Lehman Brothers and Bear Stearns - happened to collapse in 2008, triggering a global economic panic and unfolding the recent financial crisis. According to Bebchuk et al. (2010), in spite of obvious mismanagement the executives of these banks had received considerable performance-based compensation packages during the years preceding the financial crisis. It stands to reason that the effectiveness of such compensation schemes have since become subject of ever more heated discussions, not least in international banking. Sure enough, the recent rise in executive compensation has not been confined to the banking industry. Other industries have been following the same trend. Murphy (2013) documents that total pay for executives in the S&P 500 exploded in the late 2000s.

This general development has also piqued the interest of economists, who are particularly intrigued by the underlying pay-setting mechanism. Executive compensation is a classic example of a principal-agent problem and lies at the heart of the controversy of corporate separation of ownership and control (Jensen and Meckling 1976). Put succinctly, the challenge lies in motivating the CEO (the agent) to act in the best interest of the shareholder (the principal). Because the effort of the agent is not perfectly observable, the principal is not able to force the agent to choose the action that would be optimal from the principal's perspective. This invokes a moral hazard problem. There has been much discussion how and in what way firms are to solve this agency problem (Ross 1973, Gjesdal 1982, Mahoney 1995). A straightforward solution would involve a compensation scheme which provides desirable incentives for the CEO.

This is where relative performance evaluation (RPE) comes in (Holmstrom 1982). RPE implies that compensation contracts should be linked to firm performance in relation to peers with similar characteristics. Such contracts account for common shocks that are out of the agent's control and thus offer a more conclusive way to assess the agent's individual performance. Moreover, RPE contracts offer the same incentives as contracts based on absolute performance. The case for employing RPE in executive compensation contracts seems clear-cut. Indeed, RPE has become seemingly popular in practice. For example, recent studies suggest that roughly every fourth firm in the S&P 1500 openly claims to use RPE in their compensation contracts (Carter et al. 2009, Gong et al. 2011).

In this paper, we test the existence of RPE in international banking and pay particular attention to banks that seem to purport its application. This is a particularly intriguing issue given that banks might have incentives to misreport RPE practice if their board of directors are prone to the managerial influence. The board members might actually have financial and non-financial incentives to satisfy executives. For example, managers of large banks usually enjoy a great reputation outside of the bank which could be very beneficial for the members of the board. As noted by Bebchuk and Fried (2003) and Bebchuk and Fried (2004), they also enjoy a great authority within the company and as such directors, just like other employees, are naturally inclined to avoid any sort of conflict

with the manager. As a consequence, executive compensation schemes endorsed by the board of directors are created in a manner favourable to executives. However, if managerial compensation packages are recognized as flagrant by the public, managers face social disapproval and criticism. This is denoted as "outrage" costs by Bebchuk and Fried (2004). The stronger the negative perception of the public and shareholders, the larger the managers' cost of enjoying enormous compensation packages. This criticism can be avoided by camouflaging compensation packages.[1] Hence, the ability to camouflage the peer group of the underperforming bank manager would actually make his excessive pay look more acceptable and legitimate to the public and investors. Against this background, it comes as not surprise that banks would rather avoid evaluating the performance of their underperforming manager relative to the performance of their peer group.

RPE has been extensively investigated empirically. However, the scope of the existing studies is rather limited. Thereby, the focus is on compensation practices of industrial firms, and most studies exclusively use U.S. data.[2] This regional limitation comes as no real surprise. It is difficult to obtain comprehensive data on executive compensation outside of the U.S. Despite the ubiquitously proclaimed use of RPE in practice, the empirical results of these studies have been a mixed bag.[3] This is partly owed to the fact that the post hoc construction of the peer groups is rarely open to scrutiny. If the econometrician identifies a different peer group than the target firm itself had actually used, inferences on RPE are no longer meaningful. Yet peer group identification in managerial performance benchmarking is only one reason why one may fail to find evidence of RPE. A simpler explanation would be that the RPE claims are merely empty rhetoric to appease proponents of good corporate practice. As Albuquerque (2009) puts it, any empirical tests of RPE are, in this sense, joint tests.

This paper embraces this duality and tests for RPE in a new sample of large and globally operating non-U.S. banks.[4] We contend that the global banking industry is an ideal playground to test the usage of RPE, for at least three reasons. First, RPE makes especially sense for firms that are exposed to common shocks. This applies particularly well to international banking. The main reason for this exposure is that banks are highly leveraged institutions. Around 90 percent of their assets come from debt, making them more prone to exogenous volatility (Houston and James 1995, Chen et al. 2006). Second, the barriers to global integration in the banking industry have been significantly trimmed in

[1] This is known as the managerial power hypothesis developed by Bebchuck and Fried. It is depicted in more detail in Chapter 1.

[2] Antle and Smith (1986) examine RPE in a sample of chemical, aerospace, and electronics firms. Rajgopal et al. (2006) cover a wide range of industries with the three largest groups being Electric, Gas, and Sanitary Services, Chemicals and Allied Products, and Depository Institutions. Aggarwal and Samwick (1999b) and Aggarwal and Samwick (1999a) exploit ExecuComp data, restricting them to U.S. firms. Joh (1999) tests RPE on a sample of Japanese firms in the manufacturing sector.

[3] For example, Gibbons and Murphy (1990), Albuquerque (2009), and Black et al. (2015) find empirical support for the RPE hypothesis. In contrast, Janakiraman et al. (1992), Antle and Smith (1986), Aggarwal and Samwick (1999b), Jensen and Murphy (1990), and Antle and Smith (1986) fail to provide evidence for RPE or present mixed results.

[4] U.S. banks were excluded in our analysis because of a regulatory event during the observed timeframe (see Section 2.3.1 for details). To our knowledge, there are only two studies that test RPE on U.S. banks, Barro and Barro (1990) and Crawford (1999). We elaborate on them in Subsection 2.2.1.

the last two decades, shifting banks from once highly centralized domestic organizations to global behemoths. In turn, the structure of competition in the industry has adjusted (Berger and Smith 2003). Hence, large banks operating at the international level are now dealing with intense competition.[5] Third, the recent financial crisis was characterized by failures of large international banks such as Northern Rock, Bear Stearns, or Lehman Brothers. The downfall of these banks has drawn increasing attention to corporate governance issues in remuneration policy.[6] If anything, this pressure has prompted banks to make more efficient use of RPE.

Our study tackles the caveat that the soundness of empirical tests on RPE critically hinges on the correct identification of the peer groups in a company's CEO's relative-performance based pay. We follow the sophisticated approach by Albuquerque (2009) and aggregate peer performance on the basis of industry and industry/size peer groups. Aggregating in this manner accounts for the observation that industry affiliation and firm size are informative proxies for the common market risks that RPE-setting firms face. This approach, then, takes up Holmstrom's (1979) theoretical requirement of common uncertainties. Our study also deals with the potential issue of RPE being corporate cheap talk. If that were the case then signalling the disclosure of peer group usage would be mere noise, and incorporating this information should not alter our results qualitatively. To test this hypothesis, we differentiate between disclosing and non-disclosing banks. Hence, disclosing banks claim to compare the firm performance relative to a peer group performance in determining one or several components of the executive pay.[7]

We collect a new data set with information of 42 large international banks. The results of our basic regression specification document negative and insignificant parameter estimates in industry peers. Taken by itself, this casts doubt on the use of RPE in our sample. However, when we perform tests of RPE on more nuanced industry/size peers, we find moderate evidence consistent with RPE. When further restricting attention to the subsample of disclosing banks, we find stronger and more conclusive evidence that systematic risk is filtered out from CEO compensation. Strong-form RPE tests support this conclusion. This finding stands in contrast to Gong et al. (2011), who do not find informational value in RPE disclosure among U.S. firms.[8] To gain more insight, we disentangle the main drivers of RPE. A logistic regression indicates that firm size and growth options play a major role in determining the likelihood of RPE usage. The results imply that the greater a bank is, the higher is the probability that it will use RPE in its compensation contracts. On the other hand, the probability of using RPE is decreasing with the magnitude

[5] Bikker and Haaf (2002) investigate the competitive conditions and concentration in banking markets of 23 industrialized countries inside and outside Europe over 10 years. They form three sub-markets in terms of bank sizes for each country and estimate the corresponding competition conditions. They show that large banks operate mostly in international markets and are exposed to strong competition. On the other hand, smaller banks operate mainly in local markets and are facing less competition.

[6] Bebchuk et al. (2010) find that the pay structures in Bear Stearns and Lehman Brothers had provided top executives with overbearing risk-taking incentives. This misalignment let them focus on a company's short-term performance while paying too little attention to the long term value of the company.

[7] We collect this information from the annual reports and proxy statements of the respective banks. See Section 2.3.1 for more details.

[8] Our classification of RPE statements is less strict than Gong et al. (2011) so our estimates on its informational value are, if anything, to be interpreted conservatively. See Section 2.3.1 for more details.

of growth options.

Our paper contributes to the ongoing discussion on RPE along several dimensions. Existing studies testing RPE on banks have focused solely on U.S. data. This is hard to square with an industry that is characterized by pronounced international competition. We provide broader evidence by conducting tests on a newly collected sample of large international banks from 2004 to 2013. In addition, we determine the main drivers of RPE in this industry. Both tasks rely on a sound and accountable peer group construction mechanism, adding to the conclusiveness of our findings. We also shed new light on the informative value of disclosure over time. Our results suggest that the banks in our sample which proclaim the use of peers in assessing the performance of their CEOs are not merely window dressing: We do find stronger evidence for RPE usage among disclosing banks. For our sample, this would imply that lumping together disclosing and non-disclosing firms can be detrimental to the conclusiveness of RPE tests.

The rest of the paper is organized as follows. Section 2.2 describes the main characteristics of the banking industry. The section also introduces the empirical model and depicts the peer group construction mechanism. Section 2.3 presents our novel dataset of international banks. Section 2.4 reports summary statistics and regression results. In Section 2.5, we identify the main drivers of RPE in our sample. Section 2.6 concludes.

## 2.2 Relative performance evaluation and the banking industry

### 2.2.1 Executive Pay in the Banking industry

This section discusses current executive compensation practices in the banking industry. The literature on executive compensation in the banking industry attends to the particularities of the banking industry. The literature stresses three characteristic features of banks (John and Qian 2003, Macey and O'Hara 2003, Tung 2011). First, banks have a peculiar capital structure. They hold much less equity than other companies, rendering them highly leveraged. Roughly 90 percent of the funds in banks comes from debt. Moreover, a bank's assets and liabilities are mismatched (Diamond and Dybvig 1983). Second, the presence of federal guarantees of bank deposits, as a public measure to protect private depositors from losses in case of insolvency, differ then from other firms. Third, these deposits can increase the risk of fraud and self dealing in the banking industry because it reduces the incentives for monitoring (Macey and O'Hara 2003).

As a consequence two main branches of academic literature on executive pay in the banking industry have evolved (Houston and James 1995). The first branch discusses how the sensitivity of executive compensation to the bank's performance was affected by the U.S. corporate control market deregulation (Crawford et al. 1995, Hubbard and Palia 1995, Cuñat and Guadalupe 2009).[9] The second branch in the literature questions

[9]Since 1980 many states in the U.S. have passed so-called interstate banking laws that allow local banks to be acquired by out-of-state banks. This has led to higher competition among banks on the interstate market and has had consequences on the pay-performance relation.

whether the existing compensation policies promote risk-taking in the banking sector. These studies examine the relation between the specific component of the compensation and market measures of risk (Houston and James 1995, Chen et al. 2006). The results are inconclusive.[10]

Though limited, the empirical literature on CEO pay in the banking industry provides some insight about their remuneration practice. The data show that bank CEOs receive less cash compensation on average, are less likely to participate in a stock option plan, and hold fewer growth options than CEOs in other industries. These differences are likely to stem from different investment opportunities of banks (Houston and James 1995). But not all is different in the banking industry. Houston and James (1995) do not find any differences between banking and non-banking industries regarding the overall sensitivity of pay to performance. They presume that the factors that influence compensation in the banking industry are similar to those in non-banking industries despite differences in the compensation structure. Adams and Mehran (2003) suggest that the difference in the governance structures between manufacturing firms and banks are industry-specific. Furthermore, the differences seem to be mostly due to different investment opportunities of bank holding companies (BHCs) and pertinent regulation (Adams and Mehran 2003). Adams and Mehran's study questions if firm performance measures are influenced by the governance structure. Their results indicate that differences between the board structures of manufacturing firms and banks might not be a reason for concern in this respect. Aebi et al. (2012) study the strength of incentive features of top management compensation contracts in banks. They compare the pay-performance sensitivity in banks with those in manufacturing firms and show that debt ratio, firm size, risk, and regulation are important determinants of pay-performance sensitivity in banks. Finally, the executive compensation structure and the governance structure of banks differ from firms in other industries. Even so, the factors that influence the overall pay-performance sensitivity do not seem to differ significantly across industries.

Studies testing RPE in the banking industry are rare. Barro and Barro (1990) test RPE on a data set that covers 83 commercial banks in the U.S. between 1982 and 1987. They regress the growth rate of real compensation on the average of the real total rate of return from the current and previous period, the first difference of accounting based returns, regional averages for both accounting-based return, and the average of the real total rate of return. This effectively compares the performance of banks relative to the performance of other banks in the same region. Their evidence is not consistent with the use of RPE. Crawford (1999) tests two hypotheses on 215 executives from 118 U.S. commercial banks from 1976-1988. He regresses change in CEO pay for a specific bank on a change in shareholder wealth for that bank, an industry relative performance measure, and a market performance measure using S&P 500 returns. His findings suggest that relative compensation is negatively related to market and industry returns and positively related to shareholder returns. In addition, in his sample the use of RPE increases upon introduction of banking deregulation. Crawford reports evidence consistent with RPE if

[10]For example, Saunders et al. (1990) find evidence for this hypothesis and observe a positive and statistically significant relation between bank risk and stock held by the executive. In contrast, Houston and James (1995) provide results that are inconsistent with this hypothesis.

CEO compensation is evaluated relative to industry peers. He does not, however, find evidence of RPE when using market performance measures.

To sum up, two branches in the academic literature on CEO pay have evolved as a consequence of bank particularities. The first one tries to identify the effect of U.S. corporate control market deregulation on the sensitivity of executive compensation to bank performance. The second branch investigates whether compensation policies promote risk taking in the banking sector. The literature on RPE in the banking industry is scarce and virtually non-existent for the non-U.S. market.

### 2.2.2 Empirical model

We employ a model that is based on Holmstrom and Milgrom (1987). Specifically, we use the following weak-form test of RPE:[11]

$$Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it} \tag{2.1}$$

$Comp_{it}$ measures executive compensation in monetary terms, $FirmPerf_{it}$ stands for the performance of firm $i$ measured as the continuously compounded gross real rate of return to shareholders (assuming that dividends are reinvested), and $PeerPerf_{it}$ denotes the performance of firm $i's$ peer group. In order to account for variation not included in the firm's and the peer groups' performances we include several control variables, subsumed in the column vector $C_{it}$, which account for firm size and growth options. In addition, we include time, industry, and country dummies. The subscript $t$ denotes the respective year and $\epsilon_{it}$ represents an independent firm specific white noise process. Furthermore, $\alpha_0$, $\alpha_1$, $\alpha_2$, and $\alpha_3$ denote model parameters.[12]

In this model, rejecting the null hypothesis $H_0 : \alpha_2 \geq 0$ against the one-sided alternative $H_1 : \alpha_2 < 0$ provides evidence of RPE in executive compensation contracts. In that case, exogenous shocks outside of the control of the executive management are filtered out from the compensation contract.

In order to examine whether all exogenous shocks were removed from the compensation contract, researchers typically use the so-called strong-form RPE test. The first step in conducting this test is to regress firm performance on peer performance (Antle and Smith 1986). For this purpose, we employ a battery of peer performance aggregation methods (see the next section). The first step regression model is:

$$FirmPerformance_{it} = \gamma_i + \beta_i \cdot PeerPerformance_{it} + \epsilon_{it} \tag{2.2}$$

The unsystematic and systematic performance are obtained from the equation above in the following manner:

$$\begin{aligned} &UnsysFirmPerformance_{it} = \widehat{\epsilon_{it}}, \\ &SysFirmPerformance_{it} = \widehat{\gamma_i} + \widehat{\beta_i} \cdot PeerPerformance_{it}. \end{aligned} \tag{2.3}$$

[11] Originally, Holmstrom and Milgrom (1987) defined RPE as $\frac{\alpha_2}{\alpha_1}$. They test $H_0 : \frac{\alpha_2}{\alpha_1} \geq 0$ against the alternative $H_1 : \frac{\alpha_2}{\alpha_1} < 0$. Since $\alpha_1$ is expected to be positive, most of the literature that uses the model proposed by Holmstrom and Milgrom test whether $\alpha_2 < 0$. We follow their approach.

[12] Note that $\alpha_3$ is a row vector.

Note that $\widehat{\epsilon_{it}}$ denote regression residuals and $\widehat{\gamma_i}$, $\widehat{\beta_i}$ parameter estimates. Since the goal is to differentiate between systematic and unsystematic firm performance, we do not account for control variables in this step. The second step estimates the sensitivity of CEO compensation with respect to the unsystematic and systematic components of firm performance, that is:

$$Comp_{it} = \delta_0 + \delta_1 \cdot UnsysFirmPerformance_{it} + \delta_2 \cdot SystFirmPerformance_{it} + \delta_3 \cdot C_{it} + \epsilon_{it} \tag{2.4}$$

If the systematic risk is filtered out from the compensation contract, the systematic performance $\delta_2$ in equation (2.4) should not be significantly different from zero. $C_{it}$ denotes a column vector of control variables and the row vector $\delta_3$ its coefficients.

## 2.3 Data description

This section describes the data preparation process in creating our sample of international banks. Subsection 2.3.1 reports the collection of the international compensation data, Subsection 2.3.2 provides details about the sample that we use in the regression analysis, and Subsection 2.3.3 documents the peer group data selection process.

### 2.3.1 Compensation data

There is no standardized database for international corporate executive compensation. We collect data from several sources for the years 2003-2014. Financial and accounting data are obtained from Thomson Reuters Datastream and Thomson Reuters Worldscope. Compensation data are collected manually either from annual reports or management proxy circulars available online. We do not include U.S. banks in our analysis as in August 2006 a new regulatory requirement by the U.S. Securities and Exchange Commission mandated, among other things, full disclosure of peer group compositions (if applicable) for fiscal years ending on or after December 15, 2006. In a recent study, Faulkender and Yang (2013) suggest that this event generated a structural break in peer group selection, discouraging the use of U.S. compensation data for our purpose.[13] For the other countries in our sample, we could not find any corresponding regulation that was introduced in our observed timeframe.[14]

Our initial data set is composed of firms classified as banks from the FTSE All World Index with an index weight higher than 0.02. This yields 75 firms. Based on this list we collect remuneration data for 42 different firms with a total of 318 firm-year observations (henceforth dubbed the "full sample"). In line with the source information, we quantify the compensation in nominal terms. As CEO compensation we define the compensation paid by the parent company as well as the one paid by subsidiaries (for the CEO position). In rare cases firms only provide a certain wage range. In that case we always include

[13] We retain U.S. banks as possible peers, however. See Section 2.3.3.

[14] For E.U. firms, for example, Ferrarini and Moloney (2005, p. 318) point out that peer group disclosure is not required. We are not aware that this has changed since 2005.

the higher bound as the actual compensation. We do not include the measure of CEO compensation changes in the value of existing firm options and stock holdings owned by the CEO.

In order to collect the total compensation data we focus on the amount the firm itself defines as the "total". This always includes all the positions used for the fixed compensation amount as well as performance-related components. The name and the exact composition of these performance-related components vary significantly between firms. For example, some firms differentiate between long-term and short-term incentives, whereas others just talk about bonuses. This seems to be related to the pertaining country and its national regulations. We ignore any extraordinary compensation such as restricted shares (which had been allocated when starting as CEO), payment in lieu of notice, or buyout. We also exclude all amounts received related to the holding of a director position in addition to the CEO position.

In addition to the compensation data we collect information to create a dummy variable that indicates the disclosure of peers selected to determine a company's CEO's relative-performance based pay. We translate such disclosure as indication of RPE usage and examine the subsample of thusly disclosing firms in Section 2.4.2. We then identify possible drivers of disclosure in Section 2.5. Note that this approach is less excluding than a strict requirement of overt RPE claims (for details, see Gong et al. 2011). This runs the risk of not rejecting the null hypothesis even if it is false. If we do find evidence against the null hypothesis, however, we can be quite confident that disclosure has a significant impact.

### 2.3.2 International banking sample

We convert all compensation data into U.S. Dollars by using exchange rates from Thomson Reuters Datastream. The exchange rate is determined by the day after the end of the fiscal year (e.g., if the fiscal year ends on December 31, 2010, we take the exchange rate on January 1, 2011). We measure firm performance with stock market return data from Thomson Reuters Datastream. Following the literature, we control for firm size (sales) (Smith and Watts 1992, Fama and French 1992) and growth opportunities (Fama and French 1992). In addition, we include dummies to control for year-specific differences in the level of compensation, industry dummies that capture unobservable variation at the industry level, and country dummies that capture any country specific variation (e.g., due to different regulations or legal directives). In order to control for this possible country specific heterogeneity, we only keep banks from countries with at least two banks.

Panel A of Table 2.1 shows the full sample, and the RPE disclosure and non-RPE disclosure subsamples frequencies for each year. Altogether, the data for the full sample are equally well distributed over the years 2004-2013, though the frequency of the data tends to increase somewhat over time.[15] The same applies for the both subsamples.

Panel B of Table 2.1 displays the sample frequency by industry group within the banking industry. In addition, it reports the frequency of RPE disclosing and non-disclosing

[15]The low number of firms in the last year is because not all firms in our sample had yet released proxy circulars by the time we collected the data.

banks by industry group. Subsector 6029 (Commercial Banks) dominates the full sample with more than 80% of all observations. The other subsectors are National Commercial Banks (6021), State Commercial Banks (6022), Federal Saving Institutions (6035), and Security Brokers and Dealers (6211). Similar to the full sample results, RPE disclosing (41.82%) and non-RPE disclosing banks (42.71%) belong to the subsector 6029 (Commercial Banks). All the banks belonging to the subsector 6022 (State Commercial Banks) and the subsector 6035 (Federal Saving Institutions) disclose the peer group in benchmarking the performance of their CEO in the compensation policy.

Panel C of Table 2.1 depicts the sample frequency by country. Furthermore, it documents the frequency by country of the RPE and non-RPE subsamples. Among the 14 countries in the full sample, Canada together with Australia, Singapore, Sweden, and the United Kingdom provide the largest share of our banks. The banks in Canada, Australia, Germany dominate in our sample when it comes to the RPE disclosure in their annual reports. All the banks in Australia and Germany disclose information about their peer group, where as none of the banks in Singapore, Hong Kong, China and Norway provide such information.

[Insert Table 2.1 about here]

Table 2.2 shows Pearson correlation coefficients between performance measures and the control variables firm size and growth options. Firm stock returns and industry as well as industry/size peers display positive correlations (0.73 and 0.80, respectively). The correlation of firm stock returns with its industry peer is lower than the correlation of firm stock returns with its industry/size peer, which is consistent with previous evidence (Albuquerque 2009). The statistically significant correlation coefficients increase our confidence that that industry and industry/size peers are eligible candidates to filter out noise from the individually observed firm performance measures. In addition, total executive compensation is positively and significantly correlated with the firm stock return (0.15). The same applies for the correlation between the total compensation and industry, and industry/size peer return. This coefficient is, however, not significant at 1% level but at 5% level. As expected, the total compensation is positively correlated with firm size.

[Insert Table 2.2 about here]

### 2.3.3 Peer Group Composition

For the selection of possible peer firms, we start with a comprehensive list of 4228 firms, most of which are financials. We use SIC-codes to remove firms which do not belong to the banking industry.[16] We also exclude other firms which we do not consider valid peers, such as the Allied Irish Banks, which technically became state-owned during the financial crisis. We then apply a number of screens to the return data to obtain a qualitatively sound

[16]Datastream provides up to five different SIC codes for each firm, in order of relevance. We include a firm if the first SIC code is one of the following: 6021, 6022, 6029, 6035, 6036, 6061, 6062, 6081, 6082, 6091, 6111, 6141, 6159, 6162, or 6712. If the first SIC code is either 6311, 6211, 6153, 6163, or 6221, we include the firm only if one of the four other SIC-codes is in the previous list.

data set (Ince and Porter 2006). First, we delete any consecutive zero returns at the end of the sample period. Second, we remove returns below -80% and above 300%. We also require that the one-year continuously compounded return obtained from monthly data is available. We end up with 1,570 firms which form the pool of potential peers in our analyses. Note that this sample also contains so-called "dead stocks" which were delisted from the stock market during the sample period to mitigate survivorship bias.

We build the peer groups by adapting the industry/size approach by Albuquerque (2009). She constructs groups based on both the two-digit Standard Industrial Classification System (SIC) level and firm size. The first step in her construction sorts firms by beginning-of-year market value into size quartiles within an industry. This yields four peer groups per industry. Each firm is then matched with an industry/size peer group. It turns out that this approach yields stronger empirical support for the use of RPE in executive compensation than sorting by industry classification alone, an improvement that is due to the information that firm size captures. Firms of similar size are also similar along several other characteristics that proxy for systematic risk. Albuquerque shows how the levels of diversification, financing constraints, and operating leverage vary with industry/size-ranked portfolios and provides evidence that firm size subsumes these characteristics. She finds that larger firms tend to be more diversified, have greater operating leverage, and smaller financing constraints. This claim is supported by other literature (Demsetz and Strahan 1997).

## 2.4 Results

### 2.4.1 Full sample results

This section presents the results for the full sample of banks. First, we show descriptive statistics of compensation data, performance measures, and firm characteristics (Subsection 2.4.1.1) for the 42 firms across the 2004-2013 time span. Subsection 2.4.1.2 then documents the regression results. We regress the logarithm of total CEO compensation on firm stock performance, peer return, and several control variables.

#### 2.4.1.1 Summary statistics

Table 2.3 presents descriptive statistics for the full sample. We report two measures of compensation: total compensation and the logarithm of total compensation. In the regression analysis, we use the logarithm of total compensation as a dependent variable because its empirical distribution is more symmetrical than the one for total compensation. This mitigates heteroscedasticity as well as extreme skewness and allows for a direct comparison with results from previous studies (Murphy 1999). We aggregate peer performance based on industry affiliation and on the industry/size approach (Albuquerque 2009). Summary statistics for the control variables firm size (log of sales and sales) and growth options are also reported. The results show that the average (median) total compensation of an executive in our sample is USD 5.44 million (USD 4.31 million), which is not all that surprising in a sample that largely consists of the major global players in

the banking industry.[17] Firm performance is measured using log-returns. The mean firm stock return is 6% and the median is 14%. Averages of peer returns hover around 8%. The average (median) size of a bank in our full sample is USD 30240 million (USD 19225 million).

[Insert Table 2.3 about here]

#### 2.4.1.2 Regression results

We proceed to test the use of RPE in CEO compensation with equation (2.1). Peer groups are constructed with the industry and industry/size approach. We then regress the logarithm of total CEO compensation on firm stock return, peer return, growth options, and log of sales. Year, country, and industry dummies are also included.

Panel A of Table 2.4 shows the sensitivity of CEO total compensation to RPE when using industry and industry/size peer groups. The coefficient on firm stock return is positive and statistically significant at the 1% level for both peer group specifications, with values of 0.47 and 0.56 for the industry and industry/size specifications, respectively. When the peer group is restricted to firms within the same industry the coefficient of the peer portfolio is negative yet insignificant (-0.06 with a p-value of 0.78).[18] Put differently, the performance of these peers does not seem to be filtered out from the CEO compensation contracts. However, if we include size into sorting and consider industry/size peers, the parameter estimates are negative and statistically significant (with a coefficient of -0.31 and a p-value of 0.09).[19] Even so, we consider this result only as moderate evidence of RPE. The peer group coefficient is significant at the 10% level (5% if we use the more suited one-sided test) but robustness checks with self-created size sorting algorithms yield mixed results.[20]

[Insert Table 2.4 about here]

By and large, the results for our international banks dovetail with previous findings for U.S. firms, which also showed that industry/size peers are better able to capture exogenous shocks than industry peers alone (Albuquerque 2009).

[17] See A.3 for a list of the banks in our analysis.

[18] In untabulated results we repeat Albuquerque's tests using changes regression and report qualitatively similar results.

[19] This result does not hold when we repeat the changes regression procedure presented in Albuquerque (2009). In untabulated results, we report insignificant coefficients on industry/size peer returns.

[20] Although the results are robust across different treatments of standard errors (see A.2 for more details), we are not able to document robustness when we generalize Albuquerque's (2009) simple sorting specification. Specifically, we implement a novel Kernel-based peer group construction approach, presented in detail in Chapter 3, with three different Kernel-functions: a standard normal pdf (Knor), a "cosine" pdf (Kcos), and a uniform distribution pdf (Kuni). These generalized approaches give different weights depending on the peers' size "distance" from the target firm's size. The results from these new specifications are reported in Table A1 in A.1.

## 2.4.2 RPE subsample results

### 2.4.2.1 Weak tests of RPE

The results above are moderately consistent with the notion that the banks in our full sample compensate according to an RPE scheme. We now turn to the informational value of peer disclosure. Although there is a risk of taking such disclosure at face value, we exploit this information to sharpen our sample's profile. In this subsection we test the sensitivity of CEO pay to RPE in the subsample of banks that explicitly state the use of peers in determining the performance of their CEOs in their statement proxies (see Section 2.3.1). We follow the same empirical specification used in the previous section and take a closer look at 25 disclosing banks, which form 156 firm-year observations from 2004-2013.

Panel B of Table 2.4 shows the sensitivity of CEO total compensation to RPE in the subsample when using industry and industry/size peers. The results show positive and statistically significant parameter estimates on firm stock performance for both peer group specifications. The estimates are 0.49 and 0.68, respectively, indicating that a CEO is being rewarded for positive firm performance. Hence on average, CEO compensation increases with firm performance. When the peer groups are composed of banks within the same industry, the coefficient on the peer portfolio is negative and statistically insignificant (with a coefficient of -0.30 and a p-value of 0.40). The industry/size parameter estimate is also negative but statistically significant at the 5% level (with a coefficient of -0.64 and a p-value of 0.03; or 0.015 when we use the one-sided test). What is more, in contrast to the full sample, this result is robust across different self-created specifications of peer groups.[21] This goes hand in hand with our previous results and once again suggests that the industry/size approach captures more variation. The results for the subsample of disclosing banks provide again evidence consistent with RPE, but more strikingly so than the results for the full sample did. In the subsample, the coefficient on the peer portfolio doubles in size and increases sharply in statistical significance. Accounting for disclosure increases the precision of the estimates, suggesting that peer group disclosure holds informational value regarding RPE. One might also say that the inclusion of non-disclosing banks in the full sample dilutes the statistical inference and renders it less conclusive by lowering statistical power.[22] This stands in contrast to Gong et al. (2011), who find no informational value of RPE disclosure. However, their sample only comprises U.S. firms for one year.

### 2.4.2.2 Strong-form test of RPE

Following Antle and Smith (1986), we perform so-called strong-form tests of RPE on the subsample of RPE disclosures to verify the robustness of our results. Strong-form tests of RPE examine whether all the noise that can be removed is indeed filtered out from the compensation contracts. Details on the construction of systematic and unsystematic

[21] For more details see Panel B of Table A1 in A.1.4.

[22] Untabulated results for the *non-disclosing* subsample support this reasoning. On their own, non-disclosing banks do not seem to make use of RPE.

firm performances and the employed empirical model are reported in Section 2.2.2. In a nutshell, the results are consistent with RPE if only the unsystematic performance exerts influence on CEO pay, and not the systematic one.

Panel C of Table 2.4 documents the regression results from equation (2.4) for the subsample of disclosing banks. Here we regress the logarithm of CEO compensation on unsystematic firm performance, systematic firm performance, and control variables for 156 firm-year observations over the time span 2004-2013. In that specification we rely on industry/size groups for constructing the systematic performance variable. The systematic component is insignificant with a coefficient estimate of 0.14 (p-value = 0.47). The unsystematic performance variable, however, is positive and statistically significant with a coefficient of 0.68 (p-value = 0.00). This suggests that the CEOs in our subsample are being compensated for unsystematic performance only.[23] These results provide evidence in accord with the use of strong-form RPE and reinforce the previous finding that CEOs are not being compensated for systematic performance in the subsample of RPE disclosures.

## 2.5 What drives RPE in the banking industry?

Prior studies have put forth a variety of factors that influence the usage of RPE in compensation contracts (Carter et al. 2009, Gong et al. 2011, Albuquerque 2014). These studies focus on RPE usage in U.K. or U.S. firms. They do not, however, examine the influence of one factor at a time on the usage of RPE while controlling for other factors. Gong et al. (2011) investigate explicit disclosures on RPE in the U.S. to identify the factors that prompt the use of RPE in compensation contracts in 2006. Carter et al. (2009) examine the use of RPE in performance-vested equity grants in a sample of U.K. firms in 2002. This section addresses this gap and examines international firms over a longer time span. Understanding what drives RPE is instructive for its potential effect on RPE testing.

In order to pinpoint possible RPE drivers we conduct a logit regression. The dependent variable $y_{it}$ is an indicator variable that equals 1 for banks that disclose information on the use of a peer group in determining the level of executive compensation in their proxy statements, and 0 otherwise (see Section 2.3.1). The independent variables include CEO pay ($Comp_{it}$), firm performance ($FirmPerf_{it}$), various specifications of peer return ($PeerPerf_{it}$), and control variables. We control for firm size ($FirmSize_{it}$) and growth options ($GrowthOptions_{it}$) and include year ($YearDummy_{it}$), industry ($IndustryDummy_{it}$), and country ($CountryDummy_{it}$) dummies to control for cross-sectional variation. Sales are used as a proxy for the firm size. Growth options are calculated as follows: $(Market\ Equity + Total\ Assets - Common\ Equity)/Total\ Assets$.

We estimate our logit model based on the following latent variable model:

$$\begin{aligned} y_{it} = {} & \gamma_0 + \gamma_1 \cdot Comp_{it} + \gamma_2 \cdot FirmPerf_{it} + \gamma_3 \cdot PeerPerf_{it} + \gamma_4 \cdot FirmSize_{it} \\ & + \gamma_5 \cdot GrowthOptions_{it} + \gamma_7 \cdot YearDummy_{it} + \gamma_8 \cdot IndustryDummy_{it} \\ & + \gamma_9 \cdot CountryDummy_{it} + \epsilon_{it}. \end{aligned} \tag{2.5}$$

[23] These results are again robust. See Panel C of Table A1 in A.1.5.

In order to estimate equation (2.5), we use the full sample of 318 firm-year observations from 2004-2013. Table 2.5 reports the results. We find that the likelihood of using RPE is positively related to firm size and negatively related to growth options for industry and industry/size peers.[24] In other words, the probability that a bank will use RPE is increasing with firm size. The opposite holds for growth options. None of the other predictors are statistically significant, suggesting that size and growth options are the main drivers of RPE in our sample.[25]

[Insert Table 2.5 about here]

These results are in line with existing evidence. Gong et al. (2011) find that larger firms are more likely to use RPE. Firm size could represent a crude proxy for public scrutiny and shareholder concerns about compensation practices. Large firms are also more exposed to monitoring pressure in comparison to smaller ones. This might well force them to be more committed to RPE (Bannister and Newman 2003). Albuquerque (2014) and Gong et al. (2011) find that the level of RPE in CEO compensation contracts is negatively associated with a firm's level of growth options. Carter et al. (2009) examine the disclosure of performance-based conditions in equity grants and document that growth options are inversely related to the performance-based conditions. Albuquerque (2014) argues that high growth options firms have to bear more risks and thus exhibit a higher idiosyncratic variance. These firms are also characterized by firm-specific know-how and operate in markets with high barriers to entry. As a consequence, these characteristics make peer performance non-informative with respect to capturing external shocks, leading to the less usage of RPE among high growth options firms (Albuquerque 2014).

## 2.6 Conclusion

This papers tests the presence of RPE in a novel sample of 42 international non-U.S. banks from 2004 to 2013. To that end, we regress the logarithm of total compensation on firm performance, industry and industry/size peer performance, and control variables such as firm size and growth options. We control for unobservable variation in the level of compensation across years, industries, and countries. When we account for peer groups, with peer selection based on industry and firm size, we find moderate evidence for the use of RPE in international banking. This evidence becomes stronger and more robust once we focus on banks who openly disclose the use of peers in their renumeration practice. This insight contrasts and complements previous findings for the U.S.

These overarching findings suggest four things. First, large international banks seem to entertain the use of RPE in assessing the performance of their CEOs. This holds even

[24] Strictly speaking we do not examine the likelihood of using RPE but the more encompassing likelihood of disclosing peer groups. This translates into a conservative estimation. Because peer group usage is only a necessary condition for RPE, our findings are reflecting a *lower* likelihood bound of using RPE.

[25] The regression results based on our self-created Kernel-based peer group specifications are presented in Table A3 in A.1.6 and are similar to the results in this section. This approach is depicted in detail in Chapter 3.

more likely for peer group disclosing banks. The latter implies the second point: Disclosure statements seem to have some merit, at least in our sample, and credibly reflect good corporate practice on that score. Boasting firms do not seem to limit themselves to preaching water; they likely drink it, too. Third, in our sample empirical evidence on RPE runs the risk of diluting in undifferentiated data. It is worthwhile, if nothing else for robustness, to stratify by disclosure. Finally, in line with previous studies our evidence indicates that industry/size peers are better able to capture exogenous shocks than industry peers alone.

In order to identify possible drivers of RPE in international banking, we employ a logit regression model. The evidence supports the working theory that growth options and firm size play a crucial role in banks' decisions to use RPE. Our results are robust to different model specifications and dovetail with existing evidence. We find that the likelihood of RPE usage is decreasing with growth options. The implementation of RPE in high growth option banks might be too costly due to difficulties in identifying the correct peer group, rendering such banks less likely to use RPE. We also find that larger banks are more inclined to use RPE in their compensation contracts. This is hardly surprising. In light of the recent financial crisis, high levels of CEO compensation have attracted a lot of attention and large banks in particular have been under significant monitoring and shareholder pressure. In response to such pressure, large banks are more likely to have become incentivized to be committed to RPE use in determining the level of CEO pay.

Table 2.1: Sample frequency by year, SIC level, and country

Panel A: Sample frequency by year

| | Full Sample | | RPE Subsample | | Non-RPE Subsample | |
|---|---|---|---|---|---|---|
| Year | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| 2004 | 14 | 4.40 | 7 | 2.20 | 7 | 2.20 |
| 2005 | 22 | 6.92 | 10 | 3.14 | 12 | 3.77 |
| 2006 | 26 | 8.18 | 14 | 4.40 | 12 | 3.77 |
| 2007 | 32 | 10.06 | 17 | 5.35 | 15 | 4.72 |
| 2008 | 33 | 10.38 | 17 | 5.35 | 16 | 5.03 |
| 2009 | 38 | 11.95 | 17 | 5.35 | 21 | 6.60 |
| 2010 | 40 | 12.58 | 17 | 5.35 | 23 | 7.23 |
| 2011 | 42 | 13.21 | 20 | 6.29 | 22 | 6.92 |
| 2012 | 41 | 12.89 | 20 | 6.29 | 21 | 6.60 |
| 2013 | 30 | 9.43 | 17 | 5.35 | 13 | 4.09 |

Panel B: Sample frequency by SIC level

| | Full Sample | | RPE Subsample | | Non-RPE Subsample | |
|---|---|---|---|---|---|---|
| SIC Level | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| 6021 | 21 | 6.60 | 5 | 1.57 | 16 | 5.03 |
| 6022 | 8 | 2.52 | 8 | 2.52 | 0 | 0.00 |
| 6029 | 272 | 85.53 | 133 | 41.82 | 139 | 43.71 |
| 6035 | 10 | 3.14 | 3 | 0.94 | 7 | 2.20 |
| 6211 | 7 | 2.20 | 7 | 2.20 | 0 | 0.00 |

Panel C: Sample frequency by country

| | Full Sample | | RPE Subsample | | Non-RPE Subsample | |
|---|---|---|---|---|---|---|
| Country | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| Australia | 30 | 9.43 | 30 | 9.43 | 0 | 0.00 |
| Canada | 52 | 16.35 | 45 | 14.15 | 7 | 2.20 |
| China | 16 | 5.03 | 0 | 0.00 | 16 | 5.03 |
| France | 24 | 7.55 | 10 | 3.14 | 14 | 4.40 |
| Germany | 19 | 5.97 | 19 | 5.97 | 0 | 0.00 |
| Hong Kong | 9 | 2.83 | 0 | 0.00 | 9 | 2.83 |
| Malaysia | 19 | 5.97 | 2 | 0.63 | 17 | 5.35 |
| Norway | 10 | 3.14 | 0 | 0.00 | 10 | 3.14 |
| Singapore | 30 | 9.43 | 2 | 0.63 | 28 | 8.81 |
| South Africa | 14 | 4.40 | 6 | 1.89 | 8 | 2.52 |
| Spain | 20 | 6.29 | 5 | 1.57 | 15 | 4.72 |
| Sweden | 33 | 10.38 | 17 | 5.35 | 16 | 5.03 |
| Switzerland | 13 | 4.09 | 7 | 2.20 | 6 | 1.89 |
| United Kingdom | 29 | 9.12 | 13 | 4.09 | 16 | 5.03 |

Note: Panel A shows the sample frequency by year for the full sample, for the sample of RPE disclosing banks (RPE subsample), and for the subsample of non-disclosing banks (non-RPE subsample). We report the year, the frequency of the sample observation for each year, and the the yearly percentage of the sample. Panel B shows the sample frequency by SIC level for the full sample, for the sample of RPE disclosing banks (RPE subsample), and for the sample of non-disclosing banks (non-RPE subsample). We report the SIC level, the frequency of the sample observation for each SIC level, and the SIC percentage of the sample. Panel C shows the sample frequency by country for the full sample, for the sample of RPE disclosing banks (RPE subsample), and for the sample of non-disclosing banks (non-RPE subsample). We report the country, the frequency of the sample observation for each country, and the country percentage of the overall sample.

Table 2.2: Pearson correlation coefficients

| | Firm stock return | Industry Peer Return | Industry/Size Peer Return | Log(Sales) | Growth Options | Total Compensation |
|---|---|---|---|---|---|---|
| Firm stock return | 1.00 | | | | | |
| Industry Peer Return | 0.73* | 1.00 | | | | |
| Industry/Size Peer Return | 0.80* | 0.96* | 1.00 | | | |
| Log(Sales) | −0.19* | −0.09 | −0.08 | 1.00 | | |
| Growth Options | 0.42* | 0.29* | 0.28* | −0.48* | 1.00 | |
| Total Compensation | 0.15* | 0.12 | 0.11 | 0.33* | 0.04 | 1.00 |

Note: This table shows Pearson product moment correlation coefficients between total compensation, performance measures and control variables. The sample consists of 318 observations covering the time period 2004-2013. A star indicates significance at the 1% level.

Table 2.3: Descriptive statistics

| Variable | N | Mean | St.Dev. | Min | Q1 | Median | Q3 | Max |
|---|---|---|---|---|---|---|---|---|
| Total Compensation | 318 | 5.44 | 4.07 | 0.24 | 2.05 | 4.31 | 8.41 | 20.40 |
| Log(Total Compensation) | 318 | 8.25 | 0.93 | 5.46 | 7.62 | 8.37 | 9.04 | 9.92 |
| Firm stock return | 318 | 0.06 | 0.43 | -1.59 | -0.06 | 0.14 | 0.29 | 1.24 |
| Peer return (Industry) | 318 | 0.09 | 0.26 | -0.72 | -0.12 | 0.15 | 0.25 | 0.86 |
| Peer return (Industry/Size) | 318 | 0.08 | 0.31 | -0.83 | -0.07 | 0.16 | 0.27 | 0.53 |
| Firm size (Sales) | 318 | 30240 | 33396 | 1011 | 7450 | 19225 | 49384 | 142752 |
| Firm size (log(Sales)) | 318 | 16.76 | 1.12 | 13.83 | 15.82 | 16.77 | 17.72 | 18.78 |
| Growth options | 318 | 1.04 | 0.04 | 0.96 | 1.00 | 1.03 | 1.06 | 1.19 |
| Firm Stock Return Variance | 318 | 0.14 | 0.16 | 0.00 | 0.02 | 0.09 | 0.19 | 1.09 |

Note: The table shows descriptive statistics of the compensation data, firm performance measures, and control variables. Specifically, we document firm stock return and peer return. Summary statistics for peer groups are based on an industry affiliation and an industry/size quartiles approach. We report the number of firm observations (N), mean (Mean), minimum (Min), standard deviation (St.Dev.), 25th Percentile (Q1), median (Median), 75th Percentile (Q3), and maximum (Max) for the time span 2004-2013. Total Compensation and Sales are in million USD.

Table 2.4: Regressions estimating the sensitivity of CEO compensation to RPE

| | Panel A: Weak-Form RPE Tests – Full Sample | | Panel B: Weak-Form RPE Tests – Disclosure Subsample | | Panel C: Strong-Form RPE Tests – Disclosure Subsample |
|---|---|---|---|---|---|
| Independent Variables | Industry Peer Group | Industry/Size Peer Group | Industry Peer Group | Industry/Size Peer Group | Industry/Size Peer Group |
| Intercept | 3.18* | 3.22* | -3.37 | -2.78 | -2.81 |
| | (0.08) | (0.08) | (0.34) | (0.42) | (0.42) |
| Firm stock return | 0.47*** | 0.56*** | 0.49** | 0.68*** | |
| | (0.00) | (0.00) | (0.02) | (0.00) | |
| Peer return(Industry) | -0.06 | | -0.30 | | |
| | (0.78) | | (0.40) | | |
| Peer return (Industry/Size) | | -0.31* | | -0.64** | |
| | | (0.09) | | (0.03) | |
| Unsystematic Firm Perf | | | | | 0.68*** |
| | | | | | (0.00) |
| Systematic Firm Perf | | | | | 0.14 |
| | | | | | (0.47) |
| Firm size (sales) | 0.37*** | 0.37*** | 0.70*** | 0.68*** | 0.68*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Growth options | -0.59 | -0.61 | 0.17 | -0.03 | -0.03 |
| | (0.65) | (0.64) | (0.95) | (0.99) | (0.99) |
| Year dummies | yes | yes | yes | yes | yes |
| Industry dummies | yes | yes | yes | yes | yes |
| Country dummies | yes | yes | yes | yes | yes |
| Adjusted $R^2$ | 76.31% | 76.53% | 63.47% | 64.64% | 64.64% |
| Number of observations | 318 | 318 | 156 | 156 | 156 |

Note: Panel A and B show OLS regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$. The first and third column show the results from regressing log of total CEO compensation on stock return, peer performance composed of the firms within the same industry, and control variables. The second and fourth column document regression results based on the industry/size quartiles peer group approach by Albuquerque (2009). Panel A shows the results for the full sample, and Panel B reports the results for the disclosure subsample. Panel C documents OLS regression results for the equation $Comp_{it} = \delta_0 + \delta_1 \cdot UnsysFirmPerformance_{it} + \delta_2 \cdot SystFirmPerformance_{it} + \delta_3 \cdot C_{it} + \epsilon_{it}$ on the subsample of disclosing banks. We regress logarithm of CEO compensation on the unsystematic firm performance, systematic firm performance, and control variables for 156 firm-year observations over the time span 2004-2013. We use industry/size peer group specification in order to construct a systematic performance variable. All regressions include year, industry, and country dummies. For more details on systematic and unsystematic variable construction see Section 2.2.2. Significance levels are two-sided and denoted as follows: 1% $(***)$, 5% $(**)$ and 10% $(*)$. The corresponding p-values are reported in parentheses below each coefficient estimate.

Table 2.5: Logit regression of RPE use in executive compensation contracts

| Independent Variables | Industry Peer Group | Industry/Size Peer Group |
|---|---|---|
| Intercept | -25.52 | -26.08 |
| | (0.13) | (0.12) |
| Compensation | 0.47 | 0.46 |
| | (0.38) | (0.38) |
| Firm Perf | 0.00 | -0.27 |
| | (0.99) | (0.75) |
| Peer return(Industry) | 0.10 | |
| | (0.95) | |
| Peer return (Industry/Size) | | 0.89 |
| | | (0.53) |
| Firm size (sales) | 2.71*** | 2.69*** |
| | (0.00) | (0.00) |
| Growth options | -19.66* | -19.39* |
| | (0.09) | (0.10) |
| Year dummies | yes | yes |
| Industry dummies | yes | yes |
| Country dummies | yes | yes |
| $R^2$ | 51.71% | 51.79% |
| Number of observations | 318 | 318 |

Note: Table documents logit regression results for the equation $y_{it} = \gamma_0 + \gamma_1 \cdot Comp_{it} + \gamma_2 \cdot FirmPerf_{it} + \gamma_3 \cdot PeerPerf_{it} + \gamma_4 \cdot C_{it} + \epsilon_{it}$. The dependent variable is *RPE*, an indicator variable which is equal to 1 if the firm discloses the use of peer group in the compensation contracts. We regress *RPE* on firm performance, peer returns, firm size, and growth options for 318 firm-year observations over the time span 2004-2013. We also include year, country, and industry dummies in the regression estimation for two specifications, industry and industry/size peers. We report the Cox and Snell's $R^2$. Significance levels are denoted as follows: 1% ($***$), 5% ($**$) and 10% ($*$). The corresponding p-values are reported in parentheses below each coefficient estimate.

# Chapter 3

# Relative Performance Evaluation, Firm Size and Stock Returns – An empirical study

### Chapter Overview

We study the use of relative performance evaluation (RPE) in executive compensation contracts for a large sample of U.S. firms. We take into consideration various specifications of peer groups: industry, industry/size peer group, and a novel Kernel-based peer group and test which one of them is better able to capture exogenous shocks in RPE tests. The Kernel-based approach adopts firm size as a criterion for building individually specified peer groups. We report negative and statistically significant coefficients on industry/size and Kernel-based peers, which is consistent with the RPE hypothesis. However, the coefficients for the Kernel-based peers are more negative in comparison to the industry/size peers, suggesting that this method might be better able to remove noise from executive compensation contracts. The Kernel-based approach is robust across different specifications of peer weights. In addition, we construct a predicted excess executive compensation variable that arises from the use of firm and peer performance. The predicted excess compensation variable is meant to capture the RPE use in executive pay. We then investigate the association between the RPE use proxied by the predicted excess compensation variable, and firm performance. We find no such evidence.

## 3.1 Introduction

The theory of relative performance evaluation (RPE) suggests that tying executive pay to peer performance removes exogenous shocks from the observed performance of the manager, offering a better evaluation of his effort. Consequently, the unsystematic shocks are only attributed to the manager. In this manner, the compensation scheme is structured such that the manager gets paid for his own contribution to the firm's value. This theoretical prediction of RPE has been widely investigated empirically. However, the results of these studies are mixed and inconclusive. For example, Gibbons and Murphy (1990), Albuquerque (2009) and Black et al. (2015) provide evidence consistent with the RPE hypothesis. In contrast, Janakiraman et al. (1992), Antle and Smith (1986), Aggarwal and Samwick (1999b), Barro and Barro (1990), Jensen and Murphy (1990) fail to find RPE in executive compensation contracts or their results are inconclusive.[1]

The potential reasons for such inconclusive results might stem from several factors.[2] For example, biased peer groups might be one of the reasons for such results (Bannister and Newman 2003, Albuquerque 2009, Black et al. 2015, Gong et al. 2011, Lewellen 2015). In particular, industry and market indices are the most frequently used peer groups in conducting tests of RPE. This might not always represent an optimal benchmark for capturing systematic risk, especially in "significantly heterogeneous industries" (Albuquerque 2009, p.70). Murphy (2001) notes that an appropriate choice of peers is an important determinant of the effectiveness of the compensation contract. This strongly holds when the pay-setting process could be influenced by the executive compensation plan participants (Murphy 2001). In addition, different studies tend to use different measures of firm performance which plays a role when testing RPE in executive compensation contracts. For example, Albuquerque (2009) does not find empirical support for RPE when using accounting returns as a proxy for firm performance. On the other hand, she finds strong evidence consistent with RPE when using stock market returns for similar industry/size peers. Furthermore, failure to account for all the necessary control variables might lead to a misspecified empirical model and eventually to misleading results. Moreover, Cordeiro et al. (2014) investigate inter-industry differences of RPE usage and find that the use of RPE at the industry level is significantly associated with industry discretion and industry homogeneity. This might also influence inferences about RPE.

In this chapter we follow the branch of academic literature which argues that the reason for such inconclusive findings regarding RPE might be due to misspecified peer groups.[3] The ideal peer group should – to the greatest extent – capture systematic risk and share many of the firm's characteristics such as diversification, financial constraints, operating leverage, industry, and size (Albuquerque 2009). Most of the studies testing RPE use very broad peer groups, which are typically not able to subsume all the mentioned characteristics (Albuquerque 2009). There is a good reason to believe that firm size on its own is a good proxy for systematic risk and a variable that captures many of

[1] The extensive overview of the main results of the studies investigating RPE in executive pay is presented in Chapter 1.

[2] Chapter 1 reviews these factors in more detail.

[3] For example, see Albuquerque (2009), Gong et al. (2011), Lewellen (2015) and Jayaraman et al. (2015).

the firms' properties. It should be therefore taken into consideration when constructing peers.[4] Against this background we build peer groups by adopting a similar approach implemented in Albuquerque (2009) and conduct implicit RPE tests. However, we believe that there is room for improvement in Albuquerque's approach, and adopt a more refined peer group method – a Kernel-based approach. This method is more adjustable in terms of firm size. Instead of fixed-size peer groups, each firm in the sample is assigned a unique, individual peer group based on the target firm's size.

In this study we conduct the implicit RPE tests as solely relying on explicit disclosures of RPE may undervalue the prevalence of RPE in practice (Black et al. 2015, Dikolli et al. 2013). Moreover, the study by Faulkender and Yang (2013) indicates that U.S. firms do not compose less-biased peer groups after the introduction of new, stricter disclosure rules in 2006. Namely, in 2006 the U.S. Securities and Exchange Commission (SEC) adopted changes to the disclosure rules regarding executive compensation. Under the new regulation a company should disclose more details on the executive pay design and how executive pay is related to the corporate performance. This includes information on the peer groups used in managerial performance benchmarking. Contrary to the expectations, firms seem to be more inclined to choose peer companies with higher CEO pay after the rule had been passed (Faulkender and Yang 2013). These findings bring into question whether the new disclosure rules indeed resolved the problems in the compensation structure, or it rather magnified them. Taking this into consideration, implicit RPE tests matter.

We aggregate peer performance by using the industry and industry/size approaches and juxtapose them to our novel Kernel-based peer group approach in RPE tests. We test the relative performance evaluation hypothesis on a sample of 2806 U.S. firms from 1992-2011. It turns out that the parameter estimates for the Kernel-based peers and the industry/size peers are negative and statistically significant, which is consistent with RPE use in CEO compensation. There are differences in explanatory power, however. The peer coefficients on the Kernel-based peers are more negative as to the industry/size approach. This is an indication that the Kernel-based method is better able to filter out exogenous shocks from the level of CEO pay in comparison to the industry/size method. Additionally, the Kernel-based approach is robust across different specifications of the peer weights.

We also examine whether there is an association between firm performance and its tendency to use RPE. There is a literature which suggests that this might be the case. For example, Bertrand and Mullainathan (2001) argue that well-governed firms are better able to remove the "lucky" component from executive pay. This would imply that firms with stronger corporate governance are possibly more prone to RPE use in compensation contracts. Several other studies indicate that firms with good governance practice enjoy higher returns (Gompers et al. 2003, Core et al. 1999, Brown and Caylor 2004). Taking this into account, investigating whether the use of RPE in CEO-pay setting process is related to the firm performance represents an interesting consideration. In order to examine this question we adapt a methodology used in Core et al. (1999) for our purposes and build a variable labeled "predicted excess compensation" which arises from the RPE

[4]For more details on the relevance of the firm size as a proxy for the systematic risk, see Fama and French (1992), Core and Guay (2002) and Albuquerque (2009) and Jensen and Murphy (1990).

use.[5] The "predicted excess compensation" variable serves as a criterion for constructing portfolio returns for our analysis. More precisely, we sort firm stock returns by "predicted excess compensation" variable and divide them in 10 groups. We compute yearly value-weighted portfolios for each group in our sample. We then calculate the average value of the portfolio returns for each group over 1992-2011 and report t-statistics. Moreover, we employ the Carhart four-factor model in order to calculate the excess returns of the value-weighted portfolios. Our evidence suggests that there is no apparent association between the firm performance and RPE use, proxied by the "predicted excess compensation" variable.

This paper contributes to the ongoing discussion with respect to RPE along four dimensions. First, we develop a new method for individual peer group specification by introducing a Kernel based approach. This approach seems to be better able to filter exogenous shocks from the compensation contract than the traditional industry/size method. Second, we test for the presence of RPE by constructing peers based on the industry approach, the industry/size quartiles approach, and the novel Kernel-based approach. Our results are consistent with the use of RPE in CEO compensation. This adds to the literature that examines executive compensation and, in particular, tests RPE in executive compensation contracts. Third, our study substantiates the finding that firm size represents an important consideration in aggregating a peer group. This observation complements previous studies.

The remainder of this paper is organized as follows. Section 3.2 outlines the theoretical background of RPE (Subsection 3.2.1) and discusses several methods of peer group composition (Subsection 3.2.2). In particular, Subsection 3.2.2 describes a novel Kernel-based peer group approach. Subsection 3.2.3 introduces an empirical model that is used for performing RPE tests. Section 3.2.4 describes the dataset which is used for the empirical analysis. Section 3.2.5 reports summary statistics and regression results. In Section 3.3 the portfolio analysis is conducted. Section 3.4 concludes.

## 3.2 Relative Performance Evaluation

### 3.2.1 Theory of Relative Performance Evaluation

This section summarizes the theoretical foundation of relative performance evaluation (RPE). In a first step, we outline the principal-agent framework that underlies the relation between executive compensation and the performance of the firms they manage.[6] We then briefly discuss the seminal theoretical works of Holmstrom (1979, 1982) as well as the essay of Holmstrom and Milgrom (1987) on contracting, which has had useful applications in the RPE literature.

Holmstrom (1979) analyzes the principal-agent problem in a theoretical framework. In his setting only the noisy outcome of an agent's action is observable, so optimal con-

[5] Subsection 3.3.1 thoroughly depicts the methodological approach.

[6] For more information on the basic moral hazard problem and its applications to wage contracts see Salanie (2005). Furthermore, Gibbons and Roberts (2013) provide an overview of the theoretical models on agency contracts.

tracts are bound to be second-best because of moral hazard. To ameliorate the effect of negative incentives, a principal can use other available information about the agent's action or other agents' state of nature. Holmstrom (1982) refines his earlier results and shows that an "agent's sharing rules can, without loss in welfare, be written on a statistic of all observations if and only if this statistic is sufficient in the sense of statistical decision theory" (Holmstrom 1982, p.325). One application can be found in the use of relative performance evaluation in incentive contracts. Holmstrom concludes that "relative performance evaluation will be valuable if one agent's output provides information about another agent's state uncertainty. Such will be the case if and only if agents face some common uncertainties" (Holmstrom 1982, p.325). He goes on to show that compensation schemes that compare the agent's performance with aggregate measures such as peer averages are more efficient since they provide more information on common uncertainties.

Following Holmstrom (1979), Holmstrom (1982), Holmstrom and Milgrom (1987), and Gibbons and Murphy (1990), we now present a simple model of relative performance evaluation. Assume that $y$ denotes a measurable output, $a$ represents an effort of the agent, and $\epsilon$ is observational noise with zero mean. Let output be directly linked to effort as follows:

$$y = a + \epsilon \tag{3.1}$$

If output is the only observable variable, the principal will make the agent's wage contingent on it, so $w(y)$. The principal observes outcome $y$, pays wage $w(y)$ to the agent, and keeps the surplus $y - w(y)$ for himself. Holmstrom (1979) assumes that the agent receives the wage contingent on one additional variable, $z$. This makes the agent's wage a function of two variables, so we denote the wage with $w(y, z)$. $z$ is a noisy but informative signal. It provides additional information for evaluating the agent's unobservable effort. In practice this signal can be a market index or an output of some other agents.

Holmstrom and Milgrom (1987) assume that $y$ and $z$ are jointly normally distributed. Furthermore, they assume that the expected value of the new information is zero ($E[z] = 0$), the variance of the new signal is $Var[z] = \sigma_z^2$, the variance of the output $Var[y] = \sigma_y^2$, the correlation of $z$ and $y$ is $Cor(z, y) = \rho$ and the covariance between the output and the informative signal is therefore $Cov(z, y) = \rho\,\sigma_z\,\sigma_y$. Finally, $\epsilon$ denotes an error term. In this model, the optimal sharing rule is linear in $y$ and $z$:[7]

$$s(y, z) = \alpha_1 \cdot y + \alpha_2 \cdot z + \epsilon \tag{3.2}$$

Holmstrom and Milgrom (1987) calculate the regression coefficients as well as the action and profit level and observe that the additional signal $z$ is equivalent to a reduction in the variance of $y$.[8] Equation (3.2) represents a simple model of relative performance evaluation, a model that has been widely used in empirical papers to test the presence of RPE. Holmstrom (1982) suggests that the necessary information regarding the common uncertainty can be captured by an aggregate measure such as the weighted average of peer performance. RPE is thus an application of the informativeness principle: Tying the

[7] The optimal sharing rule in this context represents the wage of an agent.

[8] The reduced variance is the conditional variance of $y$ given $z$ (Holmstrom and Milgrom 1987).

income of an agent relative to his peer group filters out exogenous sources of randomness from the agent's compensation. The main advantage of relative performance evaluation is that it provides the same incentives as compensation based on absolute performance while isolating the agent's performance from exogenous sources of randomness that influence the observed performance.

## 3.2.2 Peer Group Composition

In this subsection we discuss the peer group aggregation methods we employ in the upcoming analysis. Subsection 3.2.2.1 describes the industry/size quartiles approach, whereas Subsection 3.2.2.2 points to some issues within the industry/size approach and proposes a novel Kernel-based approach. This method is similar to the one adopted in Albuquerque (2009), but more rigorous in the selection of the relevant peer group.

### 3.2.2.1 Industry/Size Peers

RPE companies assess their CEOs' compensation levels based on performance in relation to their respective peers. These peers are not simply a random draw of the market. RPE companies follow a specific methodology in selecting their peers. Most studies accessing RPE use broad industry or market indices as a comparison group for peer performance. This is not without problems. Firms within an industry are hardly homogenous in their characteristics, so simple benchmarks are not able to adequately capture common shocks (Albuquerque 2009).[9] This introduces a bias in the statistical estimation and can distort inferences. An inappropriate comparison group can lead to a higher (or lower) recommended level of CEO pay, skewing the desired incentives for CEOs. An expedient and replicable comparison group based on a reasonable and objective criterion is therefore the key element when empirically testing for RPE.

Albuquerque (2009) provides a pragmatical solution for the composition of peer groups. She constructs groups based on both the two-digit Standard Industrial Classification System (SIC) level and firm size. The first step in the construction sorts firms by beginning-of-year market value into size quartiles within an industry. This yields four peer groups per industry. Each firm is then matched with its quartile group. It turns out that this approach yields stronger empirical support for the use of RPE in executive compensation than sorting by industry classification alone, an improvement that is due to the information that firm size captures. Firms of similar size turn out to be also similar along several other characteristics that proxy for systematic risk. Albuquerque shows how the levels of diversification, financing constraints, and operating leverage vary with industry/size ranked portfolios and provides evidence that firm size subsumes these characteristics. She finds that larger firms tend to be more diversified, have greater operating leverage, and smaller financing constraints. This claim is supported by other literature.

[9] Jensen and Murphy (1990) aggregate peer performance based on the two-digit SIC level or a market index, Janakiraman et al. (1992) match their peers on the same two-digit SIC industry level. Aggarwal and Samwick (1999a) use two-, three-, and four-digit SIC levels in order to compose a peer group, and Aggarwal and Samwick (1999b) choose peers in the same two-, three- and four-digit SIC level industry or a market index.

Demsetz and Strahan (1997), for example, construct a measure of diversification of bank holding companies. Their results establish a strong, positive effect of bank size on the diversification of these firms. Moreover, they report that small firms tend to face bigger financial constraints in comparison to large ones.

In line with Albuquerque we do not argue that firm size fully captures systematic risk. However, it is a proxy with high explanatory power for the common uncertainty which Holmstrom (1982) insinuated.

#### 3.2.2.2 Kernel-Based Peer Group Construction

This section points to some issues within the industry/size approach and introduces a novel Kernel-based approach. This novel method extends Albuquerque (2009) with a more rigorous peer group selection.

To highlight the main caveat of the industry/size quartile approach implemented in Albuquerque (2009) consider the following situation. The approach partitions and ranks all firms into four size groups (per industry). The first group contains the 25% firms with the smallest firm size, and the fourth group contains those 25% of the firms with the biggest size. The boundaries between the four groups, the so-called breakpoints, lie on 25%, 50%, and 75% of the ranked values of firm size. Let us assume that we want to test the RPE hypothesis in a target company that is very close to the breakpoint between the first and the second quartile, but which just happens to fall into the first one. In this particular case it is not readily obvious why the first peer group, and not the second one, should be assigned to the target firm, which lies so close to the breakpoint.

Our method of peer group aggregation addresses this issue. Every target firm is assigned a unique peer group that corresponds to the size of that target firm. We achieve this by implementing a Kernel-based weighting scheme. Put simply, firms that are closer to the target firm in terms of firm size receive a higher weight in that firm's peer group.

We differentiate between the size of a chosen target firm and other firms in the sample. A specific weighting function assigns a higher weight to a peer firm if it exhibits a smaller distance to the target firm in terms of firm size.

We measure the differences of the firm sizes in the following manner:

$$\mathrm{D}_i = \mathrm{Size}_T - \mathrm{Size}_i \quad \text{where} \quad i = 1, ..., N \tag{3.3}$$

$\mathrm{Size}_T$ denotes the size of the target company measured in terms of firm sales, and $\mathrm{Size}_i$ is a proxy for the size of all other firms. We standardize the "distances" by dividing them with the cross-sectional standard deviation, $\mathrm{s}(\mathrm{D}_i)$:

$$\mathrm{D}_i^* = \frac{\mathrm{D}_i}{\mathrm{s}(\mathrm{D}_i)} \quad \text{where} \quad i = 1, ..., N \tag{3.4}$$

From these standardized distances, we construct weights using a kernel weighting function.[10] The firm $i$ in the sample of $N$ firms will be assigned the weight

$$\mathrm{w}_i = \mathrm{K}(\mathrm{D}_i^*) \tag{3.5}$$

[10]For the graphical representation of the different types of kernel functions see Figure B.1 in Appendix B.

Additionally, we create weights by multiplying the standardized difference with the following scaling factor (SF):

$$\mathrm{SF}_i = \mathrm{Median}\left(\frac{\mathrm{s(Size}_i)}{\mathrm{s(Size}_T)}\right) \cdot 2 \tag{3.6}$$

$$\mathrm{D}_i^{**} = \mathrm{D}_i^{*} \cdot \mathrm{SF}_i \tag{3.7}$$

$$\mathrm{w}_i = \mathrm{K}(\mathrm{D}_i^{**}) \tag{3.8}$$

For robustness we use three types of kernel functions: 1. The probability density function (pdf) of the Standard Normal Distribution, 2. the pdf of the Uniform Distribution, and 3. the pdf of the "Cosine Distribution".[11] In addition, we standardize each weight with the sum of all weights. This amounts to the following peer performance weight:

$$\mathrm{w}_i{}^{*} = \frac{\mathrm{w}_i}{\sum_{j=1}^{N} \mathrm{w}_j} \tag{3.9}$$

So that,

$$\sum_{i=1}^{N} \mathrm{w}_i{}^{*} = 1 \tag{3.10}$$

Finally, we use the performance weights and individual firm performance $\mathrm{Perf}_i$ in order to construct each target firm's peer group as follows:

$$\text{Peer Perf} = \sum_{i=1}^{N} \mathrm{w}_i^{*} \cdot \mathrm{Perf}_i \quad \text{where} \quad i = 1, ..., N \tag{3.11}$$

In contrast to Albuquerque's industry/size quartile approach that generates fixed-size peer groups, we thus allow for individual peer groups that correspond more closely to the target firm in terms of firm size. We argue that this approach is more in keeping with the theoretical models, which are built on the assumption of common uncertainties.

### 3.2.3 Empirical Model

We employ a model that is based on Holmstrom and Milgrom (1987). Specifically, we use the following weak-form test of RPE:[12]

$$Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it} \tag{3.12}$$

$Comp_{it}$ measures executive compensation in monetary terms, $FirmPerf_{it}$ stands for the performance of firm $i$ as measured by the continuously compounded gross real rate

[11] There is no Cosine Distribution to our knowledge, but if there was one this would be its probability density function.

[12] Originally, Holmstrom and Milgrom (1987) defined RPE as $\frac{\alpha_2}{\alpha_1}$. They test $H_0 : \frac{\alpha_2}{\alpha_1} \geq 0$ against the alternative $H_1 : \frac{\alpha_2}{\alpha_1} < 0$. Since $\alpha_1$ is expected to be positive, most of the literature that uses the model proposed by Holmstrom and Milgrom test whether $\alpha_2 < 0$. We follow their approach.

of return to shareholders (assuming that dividends are reinvested), and $PeerPerf_{it}$ denotes the performance of firm *i's* peer group. In what follows, we use a industry, industry/size peer group, and a novel Kernel-based approach. In order to account for variation not included in the firm's and the peer groups' performances we control for several control variables, subsumed in the control variable column vector $C_{it}$, which are explained in detail in data section. In addition, we include time, industry, and CEO dummies. The subscript $t$ denotes the respective year and $\epsilon_{it}$ represents an independent firm specific white noise process. Furthermore, $\alpha_0$, $\alpha_1$, $\alpha_2$ and $\alpha_3$ denote model parameters.[13]

In this model, rejecting the null hypothesis $H_0 : \alpha_2 \geq 0$ against the one-sided alternative $H_1 : \alpha_2 < 0$ provides evidence of RPE in executive compensation contracts. In that case, exogenous shocks outside of the control of the executive management are filtered out of the compensation contract.

The first step in conducting the so-called strong-form test is to regress firm performance on peer performance.[14] For this purpose, we employ a battery of peer performance aggregation methods. The first step regression model is:

$$FirmPerformance_{it} = \gamma_i + \beta_i \cdot PeerPerformance_{it} + \epsilon_{it} \tag{3.13}$$

The unsystematic and systematic performance are obtained from the equation above in the following manner:

$$\begin{aligned} &UnsysFirmPerformance_{it} = \widehat{\epsilon_{it}}, \\ &SysFirmPerformance_{it} = \widehat{\gamma_i} + \widehat{\beta_i} \cdot PeerPerformance_{it}. \end{aligned} \tag{3.14}$$

Note that $\widehat{\epsilon_{it}}$ denote regression residuals and $\widehat{\gamma_i}$, $\widehat{\beta_i}$ parameter estimates.

Because the goal is to differentiate between systematic and unsystematic firm performance, we intentionally do not account for control variables in this step. The second step estimates the sensitivity of CEO compensation with respect to the unsystematic and systematic components of firm performance, that is:

$$Comp_{it} = \delta_0 + \delta_1 \cdot UnsysFirmPerformance_{it} + \delta_2 \cdot SystFirmPerformance_{it} + \delta_3 \cdot C_{it} + \epsilon_{it} \tag{3.15}$$

If the systematic risk is filtered out of the compensation contract, the systematic performance $\delta_2$ in equation (3.15) should not be significantly different from zero. In that equation $C_{it}$ denotes a column vector of control variables and the row vector $\delta_3$ its coefficients.

### 3.2.4 Data

This section describes the data preparation process in creating our sample for the regression analysis in the next step. We collect data from several sources. Compensation data comes from Standard & Poor's ExecuComp database. Financial data are collected from Compustat, and stock return data are obtained from the Center for Research in Security

[13] $\alpha_3$ is a raw vector.

[14] For more details on strong-form RPE tests see Antle and Smith (1986).

Price (CRSP). Our initial sample consists of 31479 firm-CEO-year observations for the time span 1992-2011. We exclude observations with missing or negative values for sales, market value, common equity or total compensation and observations for which the CEO was employed less than a year. We also remove observations for which there was more than one CEO per year and company. Finally, we exclude performance and governance variables with missing values. In the end, our final sample for regression analysis consists of 25845 firm-CEO-year observations for 2806 U.S. firms.

Table 3.1 shows the sample frequency for each year. Most of the data are equally distributed over the years 1992-2011, though the frequency of the data tends to be smaller in 1992 and 1993.

[Insert Table 3.1 about here]

As a executive compensation proxy ($Comp_{it}$) we use total annual flow compensation in real terms. We use the natural logarithm of the real total annual compensation flow in the regression analysis, in order to alleviate heteroskedasticity, which can be a consequence of extreme skewness. This also enables a comparison with previous studies (Murphy 1999, Albuquerque 2009).[15] As a proxy for performance measures ($FirmPerf_{it}$) we use firm stock returns.[16] We construct peer performance ($PeerPerf_{it}$) by applying the industry, the industry/size (Albuquerque 2009), and the novel Kernel-based methods. These approaches are detailed in Section 3.2.2. Following Albuquerque (2009), in addition to firm stock return and peer return we use several control variables in the estimation process: firm size, growth options, CEO tenure, firm-specific stock return variance, regulation dummy, and several measures of corporate governance. Analogously with Albuquerque (2009, p.88), the regulation dummy is equal to one for the companies that belong to gas and electric industries with SIC codes from 4900 to 4939 (Albuquerque 2009, p.88). In addition, growth options are calculated as follows: $(Market\ Equity + Total\ Assets - Common\ Equity)/Total\ Assets$. In the regression analysis, we use the natural logarithm of sales as a proxy for firm size. This is common practice in the academic literature. Following Core and Guay (1999) we also use the natural logarithm of tenure in the regression analysis. Similar to Albuquerque (2009, p.88) we include three measures of corporate governance: a CEO chair dummy, a CEO ownership dummy, and an interlock dummy.[17] The first dummy takes a value of one if the CEO is a chairman and zero otherwise (Albuquerque 2009, p.88). The second one is equal to one if the CEO share ownership is lower than the median for the years across CEOs in the dataset (Albuquerque 2009, p.88). Finally, the third dummy takes a value of one if the manager is involved in interlock relationship (Albuquerque 2009, p.88).[18] Year and industry dum-

[15]Total annual compensation flow is defined as the sum of salary, bonus, other annual compensation, long-term incentive payouts, restricted stocks granted during the year, the values of stocks granted and all other compensation.

[16]Firm stock return is measured as the continuously compounded gross real shareholder rate of return assuming that dividends are reinvested.

[17]The construction of these variables is adopted from Albuquerque (2009).

[18]Interlock relationship refers to the situation when a CEO serves on the board that is making decisions about his compensation or if he is on the board of a company whose CEO is involved in decisions about the CEO's in question pay package.

mies are also included in order to control for year-and industry-specific differences in the level of compensation. Furthermore we control for CEO dummies. This accounts for differences in executive compensation emerging from some unobservable CEO features (Albuquerque 2009, p.78).

Table 3.2 reports summary statistics for our sample. The average (median) CEO total compensation is USD 3.45 million (USD 1.85 million). The total compensation is skewed as the mean of the total compensation is higher than the median. The average (Median) firm stock return is -2.0 % (8.0%). The averages (medians) of peer returns range from -6.0% (2.0%) to 1.0% (2.0 %) depending on the specification. The sales figures of the average firm amount to USD 3.9 million.

[Insert Table 3.2 about here]

In Table 3.3 we regress firm stock performance on the peer group performance and document a slope coefficient $\rho$. A higher parameter estimate on peer performance is an indication that this peer group represents a better tool for filtering exogenous shocks (Holmstrom and Milgrom 1987). When peer performance is based on industry affiliation the slope coefficient equals 0.53. When we regress firm stock performance on industry/size peers, the parameter estimate is 0.51. However, the $\rho$ on Kernel-based peers is around 1.60 suggesting that these peers might be better able to filter exogenous shocks.

[Insert Table 3.3 about here]

### 3.2.5 Results

In this section we test the use of RPE in CEO pay with equation (3.12). Peer groups are constructed with the industry, the industry/size, and the novel Kernel-based approach, respectively. We then regress the logarithm of CEO pay on firm stock return, peer return, firm size, growth options, CEO tenure, regulation dummy, firm stock return variance, CEO chair dummy, CEO ownership dummy, and an interlock dummy. We also include year, industry and CEO dummies. First, we report the results of the sensitivity of CEO pay to weak-form test of RPE. After that, we document the results of the strong-form RPE test.

Table 3.4 shows the sensitivity of CEO total compensation to RPE when using industry and industry/size peer groups. The parameter estimates on firm stock performance are positive and statistically significant for both peer group specifications. Estimates are 0.06 (p-value=0.00) for both specifications, indicating that CEO pay increases in firm stock performance. When the peer group consists of industry and industry/size peers, RPE cannot be rejected. The coefficients on both peer groups are negative with a coefficient of -0.07 and statistically significant (p-value=0.00), which is consistent with the RPE hypothesis and indicates that external shocks are filtered out of the compensation contract.[19]

[Insert Table 3.4 about here]

[19]We always report two-sided p-values.

Table 3.5 shows regression results with the Kernel-based peers. Firm stock return is again positive and statistically significant for all three Kernel-based peer groups. The coefficient on the peer return is negative and statistically significant. RPE is not rejected as the coefficient on the peer portfolio is negative and significantly different from zero. The coefficient on peer return is more negative in comparison to the industry and industry/size peer return indicating that this peer group specification may be better able to filter common shocks from CEO pay. The coefficients are, however, slightly less significant than those of the industry and industry/size peers. The parameter estimates are -0.35 (p-value=0.01) for the normal Kernel function, -0.34 (p-value=0.01) for the cosine Kernel function and -0.34 (p-value=0.01) for the uniform Kernel function.

[Insert Table 3.5 about here]

When the peer groups are based on the adjusted Kernel-based method (labeled as "scaled" in the table) the coefficients on peer returns are higher in absolute terms and statistically significant at 1% level. This suggests that this method might be better able to filter out shocks unrelated to manager's performance from the compensation contract. Table 3.6 reports the main results. Firm stock return is again positive and statistically significant for all three Kernel-based peer groups. Parameter estimates on Kernel peers do not differ much across the Kernel-based specifications. They are -0.35 (p-value=0.00) for the normal Kernel function, -0.35 (p-value=0.00) for the cosine Kernel function and -0.34 (p-value=0.01) for uniform Kernel function.

[Insert Table 3.6 about here]

Table 3.7 reports the level of CEO pay regression results from simultaneously including industry, industry/size, and Kernel-based peer groups. By including all peer group specification, we intend to test the marginal contribution of each peer group specification in eliminating common shocks from CEO pay.

The first column documents regression results when we simultaneously include industry, industry/size, and normal Kernel-based peer group. The industry coefficient is -0.05 (p-value=0.01) and the Kernel-based peer group coefficient is -0.35 (p-value=0.02). The parameter estimate on the industry/size peer group is -0.02 (p-value=0.16) and thus insignificant. The results suggest that the common shocks are eliminated through the industry and the Kernel-based peer group, but a Kernel-based peer group might be better in eliminating them since the coefficient on this peer group is more negative. The results do not differ much across Kernel peer group specifications. The second column documents the results when we simultaneously include the industry, the industry/size, and the cosine Kernel peer group. Again, the coefficient on the industry/size peer is insignificant (p-value=0.16), but the coefficients on the industry peer and the Kernel-based peer are negative and statistically significant (coefficient of -0.05 and p-value=0.01 and coefficient of -0.30 p-value=0.02 respectively). The third column reports the same estimation process, but here we include the uniform Kernel-based peer groups in addition to the industry and industry/size peers. The results are qualitatively similar to the first and second column. Thus, the results indicate that external shocks are filtered out when we use industry

and Kernel-based peer group, but the coefficient on the Kernel peers are more negative suggesting that this approach might be better able to eliminate common shocks.[20]

[Insert Table 3.7 about here]

Table 3.8 reports yet stronger results in favour of Kernel-based peers.[21] It documents the level of CEO pay regression results from simultaneously including the industry, industry/size, and the adjusted Kernel-based peers. The results in column suggest that common uncertainties are filtered out of executive compensation only through the Kernel-based peers and the industry peers. The coefficients on the Kernel-based peers are again not qualitatively different. They are -0.31 (p-value=0.01) for the normal Kernel-based peer group, -0.31 (p-value=0.01) for the cosine Kernel peer group, and -0.30 (p.value=0.01) for the uniform Kernel peer group.

[Insert Table 3.8 about here]

Next we perform the so-called strong-form tests of RPE.[22] Strong-form tests of RPE examine if all the noise that can be removed is filtered out from the compensation contract (Albuquerque 2009). Details on constructing systematic and unsystematic firm performance as well as the empirical model we employ are reported in Section 3.2.3. In a nutshell, the results are consistent with RPE if only the unsystematic performance exerts influence on CEO pay, and not the systematic one. In practice, this means that CEO is not being compensated for systematic performance.

Table 3.9 documents the regression results for equation (3.15). Here we regress the logarithm of CEO compensation on unsystematic firm performance, systematic firm performance, and several control variables for 25845 firm-year observations over the time span 1992-2011. We also include industry, year and CEO dummies. We rely on industry, industry/size, and the Kernel-based peer groups for constructing the systematic performance variable.

The first and second column of Table 3.9 show the regression estimates with systematic firm performance based on industry and industry/size peers. The systematic component is significant for the industry and the industry/size peer groups (value of 0.53, p-value=0.01 and value of 0.52, p-value=0.02, respectively). These numbers do not support the use of RPE in this model specification. In the rest of the table, we use Kernel-based peer groups to construct the systematic performance variable. We document qualitatively similar results. The systematic component of firm performance is statistically significant for the estimation with Kernel-based peers. The coefficients are 0.78 for the normal Kernel-based peer (p-value=0.03), 0.78 for the cosine Kernel-based peer (p-value=0.03), and 0.78 for the uniform Kernel-based peer (p-value=0.03). Thus, in this model specification the CEO is partly compensated for systematic performance. The same holds for the estimation results with adjusted Kernel-based peers (labeled as "scaled" in the Table 3.9 ).

[20]This reasoning is supported by the untabulated results where we repeat the same regression procedure on the standardized variables.

[21]This reasoning is again dovetailed by the untabulated results where we repeat the same regression procedure on the standardized variables.

[22]For more details on the construction of the strong-form RPE tests, see Antle and Smith (1986).

[Insert Table 3.9 about here]

To sum up, our results dovetail with previous studies. Firm size represents an important characteristic when constructing a peer group. In our sample industry and industry/size peers are equally good in filtering out exogenous shocks from the compensation contract. However, the adjusted Kernel-based peer group approach which allows for the construction of individual peer groups seems to be better in performing this task. The coefficient on the Kernel peers tends to be constantly more negative than it is the case with industry/size peers only. This result is robust across different peer group specifications. Our evidence indicates that on average some noise was removed from the compensation contract.

## 3.3 Portfolio Analysis

This section examines whether there is an association between the predicted excess executive compensation and firm performance. Precisely, we introduce a predicted excess compensation variable that captures the compensation arising from stock and peer performance. By means of this variable, we intend to capture the RPE use. In other words, we intend to examine whether firms having higher predicted excess compensation, which stems from the firm performance and peer performance, tend to under- or overperform firms with a lower predicted compensation.[23] The empirical literature provides intuition that this might be the case. Subsection 3.3.1 explains the methodology we use to examine this question. The main results are presented in the subsection 3.3.2.

There is reason to believe that well-governed firms are more inclined to remove exogenous shocks from executive compensation contracts (Bertrand and Mullainathan 2001, Garvey and Milbourn 2006). Bertrand and Mullainathan (2001) investigate how the presence of large shareholders affects the manager's pay design. In particular, they examine if this governance practice has any influence on whether managers are rewarded for "luck".[24] The study shows that CEOs in firms with large shareholders, large shareholders on the board, smaller board, and less insider board presence are better able to remove the lucky component from the compensation package. Hence, this study suggests that firms exhibiting stronger governance practices, might be more prone to the RPE use. In another study, Bertrand and Mullainathan (2000) report that CEOs with bad governance practice receive smaller reductions in cash compensation after the incentive-based component of the compensation contract is increased, suggesting that bad governance practice is related to the higher executive pay.[25] Garvey and Milbourn (2006) extend the study by Bertrand and Mullainathan (2001). They provide strong empirical evidence that executives are able to get rewards arising from good luck, whereas they are isolated from bad

[23] Namely, firms whose RPE use is stronger (higher coefficient on peer performance in absolute terms), have a lower predicted excess (executive) compensation.

[24] The authors refer to "lucky" pay whenever the pay is unrelated to the managers' performance.

[25] In the study by Bertrand and Mullainathan (2000) the absence of the large shareholders is a proxy for a bad corporate governance practice.

luck. Garvey and Milbourn show that benchmarks are only used to evaluate the CEO performance when they are rising. This result is in line with the assumption that executive compensation is not determined ex ante. On the contrary, it seems that executive pay is determined only after the performance of the benchmark has been observed. Garvey and Milbourn (2006) find that this phenomenon is particularly prevalent in companies with bad corporate governance structures.

The belief that governance best practices lead to superior firm performance is widespread in the academic literature (Gompers et al. 2003, Core et al. 1999, Brown and Caylor 2004, Wu et al. 2009, Amba 2014). Gompers et al. (2003) examine whether better governed firms tend to exhibit higher performance. For this purpose, they build a governance index that represents a proxy for shareholder rights. The index consists of several sets of governance provisions for around 1500 firms in 1990.[26] It essentially measures good corporate governance practice of firms. Furthermore, they estimate the empirical relationship between corporate performance and the index. The results support their hypothesis: firms with stronger governance practice exhibit higher firm values, profits, and sales growth – they perform better. Moreover, these firms also face lower capital expenditures and fewer corporate acquisitions. Furthermore, Core et al. (1999) present evidence suggesting that firms with weaker governance practices face greater agency problems and as a consequence, perform worse. CEOs in these firms also receive greater compensation packages. "More precisely, CEO remuneration is higher when the manager is also a chairman, the board is larger, there is a greater percentage of outside directors, and when the outside directors are appointed by the CEO or are considered gray" (Core et al. 1999, p.372). Brown and Caylor (2004), Wu et al. (2009), Amba (2014) endorse this evidence.

On the one hand, there is strong empirical evidence that better governance practices induce higher firm performance. On the other, there is some evidence suggesting that better governed firms are more likely to reward their managers with compensation schemes that are unrelated to the common risk. Against this background, it is worthwhile to consider whether there is an association between RPE (as one aspect of a good governance practice) and firm performance.[27]

### 3.3.1 Methodology

This subsection summarizes the methodology we use in order to examine the question mentioned above. Our approach is essentially based on the methodology applied in Core et al. (1999). We provide a brief overview of the approach developed in their study and then go on to show how we adjust their method for our purposes.

In their study Core et al. (1999, p.372) intend to answer two questions: 1. Are executive pay and the quality of corporate governance related? 2. Is there a link between

[26] For details on how the governance index was built, see p.114-119 in Gompers et al. (2003).

[27] To our knowledge there is only one study that investigates whether RPE use increases shareholder wealth. Tice (2015) tests whether RPE firms perform better than non-RPE firms and reports mixed results. In the overall sample she finds evidence inconsistent with the hypothesis that RPE firms generally better perform than non-RPE firms. She documents, however, that RPE firms on average perform better in comparison to the similar non-RPE firms solely when the contract is based on market-based firm performance measure.

the quality of governance practice and firm performance? In their attempt to provide answers to these questions, they find that executive pay varies with the corporate governance variables and ownership structure. Given this, they note: "The variation of CEO pay that stems from governance variables could be interpreted twofold: 1. The results might be a consequence of a misspecified model for the equilibrium wage or 2. They might be a consequence of unresolved agency problems" (Core et al. 1999, p.372). In order to plunge deeper in resolving this puzzle, Core et al. (1999) create a new variable – predicted excess compensation. This variable captures the part of the CEO pay that arises from the governance variables (board and ownership variables) in excess of the standard control variables for executive pay. Core et al. (1999, p.390) use the following equation in order to quantify this variable: $\textit{Predicted excess compensation} = \sum \widehat{\beta_i} \cdot \textit{board structure}_i + \sum \widehat{\gamma_i} \cdot \textit{ownership structure}_i$. The $\beta_i$'s and the $\gamma_i$'s are obtained in the regression of CEO pay on board and ownership variables, standard economic determinants of CEO pay, and industry and year dummies. The authors then investigate if this variable correlates with future stock market performance.

In order to set up a criterion for the portfolio analysis, we adjust the method of Core et al. (1999) in the following manner:

In the first step, we regress the logarithm of total compensation ($Comp_{it}$) on the interaction between industry and firm performance ($Industry_{it} \times Perf_{it}$), an interaction between industry, and peer performance ($Industry_{it} \times Peer\ Perf_{it}$) and several control variables ($C_{it}$):

$$Comp_{it} = \alpha_0 + \alpha_1 \cdot (Industry_{it} \times Perf_{it}) + \alpha_2 \cdot (Industry_{it} \times PeerPerf_{it}) + \alpha_3 \cdot C_{it} + \epsilon_{it} \quad (3.16)$$

We use industry, industry/size, and a Kernel-based peer group measures for peer performance, and use firm stock return as a proxy for firm performance. The list of control variables is described in Section 3.2.4.

In a second step, following Core et al. (1999) we compute a predicted excess compensation variable based on the estimated coefficients from equation (3.16):

$$\widehat{Comp}_{it} = \widehat{\alpha_0} + \widehat{\alpha_1} \cdot (Industry_{it} \times Perf_{it}) + \widehat{\alpha_2} \cdot (Industry_{it} \times PeerPerf_{it}) \quad (3.17)$$

Third step consists of portfolio construction. For this purpose we use two variables: 1. $\widehat{Comp}_{it}$ which catches the predicted compensation arising from the firm and peer performance variables. 2. Additionally we deflate the predicted compensation with total compensation in the following manner: $\frac{\widehat{Comp}_{it}}{Comp_{it}+8}$ in order to put emphasis on how much a CEO actually earns on the grounds of peer performance.

In order to construct portfolio returns for our analysis we sort firm stock returns by predicted excess compensation variable and group them into deciles. This yields 10 groups of firm stock returns for each year. We then compute yearly value-weighted portfolios for each group. We repeat the same procedure with the relative predicted excess compensation. The idea behind it is to observe whether returns of the firms with the small predicted excess compensation outperform or underperform those with high predicted excess compensation.

In order to evaluate this we calculate the average of value-weighted returns for each group over 1992-2011 and report the corresponding t-statistics. In addition, we calculate

excess returns by applying the four-factor model proposed by Carhart (1997). The four-factor model – consisting of the market, the value, the size, and the momentum risk factors – explains the cross-section of stock returns better than the simple one-factor model based on Capital Asset Pricing Model which includes only a market factor.[28] Therefore, in the regression we control for these four factors. It has become common to control for these factors in a wide range of applications such as portfolio analysis due to the fact that researchers require reliable predictions for expected returns based on an asset pricing model. The market momentum (WML), size (SMB), and value (HML) risk factors are obtained from Kenneth's French website.

### 3.3.2 Results

This subsection reports the main results of our portfolio analysis.

All tables in this section are divided into two parts. The first one reports portfolios returns sorted by the predicted excess compensation ($\widehat{Comp}_{it}$) labeled as "fitted CEO pay". The second one reports portfolio returns sorted by relative predicted compensation ($\frac{\widehat{Comp}_{it}}{Comp_{it+8}}$) labeled as "fitted relatives CEO pay". Each part of the table documents "raw" portfolio returns – averages of value-weighted returns over 1992-2011 (labeled as "raw" in tables) and excess returns calculated using the four-factor model (labeled as "FF" in tables).

In Table 3.10 we use an industry/size peer group in order to construct the predicted excess compensation and relative excess compensation variable. "Raw" value-weighted portfolios in both parts of the table show a non-monotonic behavior. The "raw" value-weighted portfolio returns sorted by predicted CEO pay variable for the first group is 0.78, the second 0.99, the third 1.03, the fourth 0.94, the fifth 1.15, the sixth 1.13, the seventh is 0.90, the eight 1.00, the ninth 1.03 and for the tenth group 1.10. The returns in all groups are statistically insignificant. We report qualitatively similar results when we empoly the Fama-French model for calculating excess returns. The excess returns for the portfolios sorted by predicted CEO pay variable for the first group is 0.39, the second 0.61, the third 0.72, the fourth 0.57, the fifth 0.72, the sixth 0.74, the seventh is 0.41, the eight 0.76, the ninth 0.71 and for the tenth group 0.55. These results are robust when we use relative CEO pay as a sorting criteria.

[Insert Table 3.10 about here]

In Tables 3.11–3.13 we use the adjusted Kernel-based peer specification in order to construct the predicted excess compensation and relative excess compensation variables. In Table 3.11 we use the normal Kernel peer group for constructing the sorting criteria. In Tables 3.12 and 3.13 we use the cosine and uniform Kernel peer groups respectively. We show qualitatively similar results as in Table 3.10. We report a non-monotonic behavior of the portfolio returns. This also holds when we adapt Fama-French methodology for calculating excess returns.[29]

[28] The Carhart's four factor model is an extension of three factor model developed by Fama and French (1993).

[29] These results are again qualitatively similar when we adopt Kernel-based peers.

[Insert Table 3.11 about here]

[Insert Table 3.12 about here]

[Insert Table 3.13 about here]

Taken together, our evidence suggests that there is no association between predicted excess compensation variable, that serves as proxy for the RPE use in our analysis, and firm performance.

## 3.4 Conclusion

This study develops a new approach for peer group aggregation – a Kernel-based peer group approach and investigates the RPE hypothesis on a sample of 2806 U.S. firms for the time period 1992-2011. The novel Kernel-based approach identifies peer groups within the same industry by taking into consideration a more precise link of firm size in relation to peer groups. In doing so, we allow for individual peers for every firm.

To that end, we regress the logarithm of total compensation on firm performance, industry peers, industry/size peers, kernel-based peers, and various control variables. We also include CEO dummies. We control for unobservable variation in the level of compensation across years and industries. In addition, we examine whether an association between RPE use in executive pay and firm performance can be empirically established. In order to examine this, we create a predicted excess compensation variable that to capture the RPE use in executive pay. We then sort firm returns by the means of this variable and create ten groups of firms. We calculate value-weighted portfolio returns and corresponding excess returns.

We find negative and statistically significant coefficients for all peer group specifications, which is in line with the notion of RPE. This indicates that on average some noise was removed from the compensation packages of a CEO. However, when we account for peer groups, with peer selection based on the Kernel methodology, the peer coefficients are more negative in comparison to other peer group specifications suggesting that accounting for Kernel peers delivers more powerful tests of RPE. This result is robust across different specifications of peer weights.

Our findings suggest four things. First, we develop a new approach for peer group selection which is robust and implementable. This approach seems to be better able to capture exogenous shocks in executive compensation contracts than traditional industry and industry/size peers. Second, the U.S. firms in our sample entertain the use of RPE in assessing the performance of their CEOs on average. Hence, on average the U.S. firms are pursuing a good governance practice with respect to RPE. Third, peer group selection seems to play a role in conducting tests of RPE. Fourth, firm size plays an important role when composing appropriate peer groups. These observations complement previous studies.

Table 3.1: Sample frequency by year

| Year | Frequency | Percent |
|---|---|---|
| 1992 | 645 | 2.13 |
| 1993 | 1165 | 3.84 |
| 1994 | 1398 | 4.61 |
| 1995 | 1481 | 4.89 |
| 1996 | 1527 | 5.04 |
| 1997 | 1549 | 5.11 |
| 1998 | 1610 | 5.31 |
| 1999 | 1580 | 5.21 |
| 2000 | 1553 | 5.13 |
| 2001 | 1532 | 5.06 |
| 2002 | 1555 | 5.13 |
| 2003 | 1634 | 5.39 |
| 2004 | 1633 | 5.39 |
| 2005 | 1555 | 5.13 |
| 2006 | 1609 | 5.31 |
| 2007 | 1755 | 5.79 |
| 2008 | 1697 | 5.60 |
| 2009 | 1701 | 5.61 |
| 2010 | 1655 | 5.46 |
| 2011 | 1467 | 4.84 |

Note: The table shows the sample frequency by year for the full sample. We report year, the sample frequency observation for each year, and the yearly percentage of the overall sample.

Table 3.2: Descriptive Sample Statistics

| Variable | N | Mean | St.Dev. | Min | Q1 | Median | Q3 | Max |
|---|---|---|---|---|---|---|---|---|
| Total Compensation | 25845 | 3.45 | 7.43 | 0.61 | 0.93 | 1.85 | 3.86 | 558.06 |
| Log of Total Compensation | 25845 | 7.55 | 1.12 | -7.40 | 6.82 | 7.52 | 8.26 | 13.23 |
| Firm stock return | 25845 | -0.02 | 0.51 | -7.21 | -0.15 | 0.08 | 0.25 | 1.36 |
| Peer return (Industry) | 25845 | -0.06 | 0.41 | -4.51 | -0.16 | 0.02 | 0.16 | 0.76 |
| Peer return (Industry/Size) | 25845 | -0.02 | 0.38 | -7.21 | -0.12 | 0.05 | 0.18 | 1.41 |
| Peer return (Knor) | 25845 | 0.01 | 0.04 | -0.28 | -0.01 | 0.01 | 0.04 | 0.18 |
| Peer return (Kcos) | 25845 | 0.01 | 0.04 | -0.61 | -0.00 | 0.02 | 0.04 | 0.19 |
| Peer return (Kuni) | 25845 | 0.01 | 0.04 | -0.28 | -0.00 | 0.01 | 0.04 | 0.18 |
| Firm size (Sales) | 25845 | 3.90 | 11.62 | 0.00 | 0.37 | 0.96 | 2.93 | 279.23 |
| Firm size (log(Sales)) | 25845 | 6.96 | 1.57 | -2.76 | 5.90 | 6.86 | 7.98 | 12.54 |
| Growth options | 25845 | 1.71 | 1.830 | 0.09 | 0.62 | 1.20 | 2.15 | 52.52 |
| Firm Stock Return Variance | 25845 | 0.02 | 0.04 | 0.00 | 0.01 | 0.01 | 0.02 | 2.20 |
| Regulation Dummy | 25845 | 0.06 | 0.24 | 0 | 0 | 0 | 0 | 1 |
| Log of CEO Tenure | 25845 | 7.76 | 0.84 | 0 | 7.20 | 7.79 | 8.35 | 10.02 |
| CEO chair dummy | 25845 | 0.54 | 0.50 | 0 | 0 | 1 | 1 | 1 |
| CEO ownership dummy | 25845 | 0.52 | 0.50 | 0 | 0 | 1 | 1 | 1 |
| Interlock dummy | 25845 | 0.05 | 0.22 | 0 | 0 | 0 | 0 | 1 |

Note: The table shows descriptive statistics of 25845 CEO-firm observations over the 1992-2011 time span for 2806 firms. We report compensation data, firm performance measures and control variables. Peer groups are based on: industry affiliation, industry/size quartiles and various specifications of Kernel-based approach. We document the number of firm observations (N), Mean (Mean), Minimum (Min), Standard Deviation (St.Dev.), First Quartile (Q1), Median, Third Quartile (Q3) and Maximum (Max). Total compensation and firm characteristics are in USD millions.

Table 3.3: Regression estimating the sensitivity of firm performance to peer performance

| Peer Group | N | $\rho$ |
|---|---|---|
| Industry | 25845 | $0.53^{*}$ |
| Industry/Size | 25845 | $0.51^{*}$ |
| Knor | 25845 | $1.60^{*}$ |
| Kcos | 25845 | $1.61^{*}$ |
| Kuni | 25845 | $1.61^{*}$ |
| Knor (Scal) | 25845 | $1.61^{*}$ |
| Kcos (Scal) | 25845 | $1.61^{*}$ |
| Kuni (Scal) | 25845 | $1.61^{*}$ |

Note: The table shows the slope coefficient $\rho$ from a pooled OLS regression of firm performance on industry, industry/size peer group and various Kernel-based peer groups. The regression is pooled on 25845 CEO-firm observations over 1992-2011 time span for 2806 firms. We report the mean coefficient ($\rho$) and the number of observations (N). Significance level is denoted as follows 1% ($*$).

Table 3.4: Regressions estimating the sensitivity of CEO compensation to RPE

| Independent Variables | Industry Peer Group | Industry/Size Peer Group |
|---|---|---|
| Intercept | $4.06^{***}$ | $4.05^{***}$ |
| | (0.00) | (0.00) |
| Firm stock return | $0.06^{***}$ | $0.06^{***}$ |
| | (0.00) | (0.00) |
| Peer return (Industry) | $-0.07^{***}$ | |
| | (0.00) | |
| Peer return (Industry/Size) | | $-0.07^{***}$ |
| | | (0.00) |
| Firm size (sales) | $0.41^{***}$ | $0.41^{***}$ |
| | (0.00) | (0.00) |
| Growth options | $0.00^{***}$ | $0.00^{***}$ |
| | (0.00) | (0.00) |
| CEO Tenure | $0.12^{***}$ | $0.12^{***}$ |
| | (0.00) | (0.00) |
| Regulation Dummy | −0.07 | −0.07 |
| | (0.87) | (0.87) |
| Firm Stock Return Variance | $0.61^{***}$ | $0.62^{***}$ |
| | (0.00) | (0.00) |
| CEO Chair Dummy | 0.02 | 0.02 |
| | (0.29) | (0.29) |
| CEO ownership Dummy | −0.02 | −0.02 |
| | (0.23) | (0.17) |
| Interlock Dummy | $0.05^{*}$ | $0.05^{*}$ |
| | (0.07) | (0.07) |
| Year dummies | yes | yes |
| Industry dummies | yes | yes |
| CEO dummies | yes | yes |
| Adjusted $R^2$ | 70.63% | 70.63% |
| Number of observations | 25845 | 25845 |

Note: The table reports regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$. The first column reports results from regressing the log of total CEO compensation on stock return, the industry peer group and several control variables. The second column reports results based on the industry/size peer group specification proposed by Albuquerque (2009). We control for firm size, growth options, CEO tenure, regulation dummy, firm stock return variance, CEO chair dummy, CEO ownership dummy, and interlock dummy. We also include year, industry, and CEO dummies. We report coefficients, adjusted $R^2$, and number of observations. P-values are reported in parenthesis. Significance levels are denoted as follows 1% ($***$), 5% ($**$) and 10% ($*$).

Table 3.5: Regressions estimating the sensitivity of CEO compensation to RPE

| Independent Variables | Knor (unscaled) | Kcos (unscaled) | Kuni (unscaled) |
|---|---|---|---|
| Intercept | $4.05^{***}$ | $4.05^{***}$ | $4.05^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Firm stock return | $0.05^{***}$ | $0.05^{***}$ | $0.05^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Peer return (Knor) | $-0.35^{**}$ | | |
| | (0.01) | | |
| Peer return (Kcos) | | $-0.34^{**}$ | |
| | | (0.01) | |
| Peer return (Kuni) | | | $-0.34^{**}$ |
| | | | (0.01) |
| Firm size (sales) | $0.41^{***}$ | $0.41^{***}$ | $0.41^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Growth options | $0.00^{***}$ | $0.00^{***}$ | $0.00^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| CEO Tenure | $0.12^{***}$ | $0.12^{***}$ | $0.12^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Regulation Dummy | −0.06 | −0.06 | −0.06 |
| | (0.89) | (0.89) | (0.89) |
| Firm Stock Return Variance | $0.62^{***}$ | $0.62^{***}$ | $0.62^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| CEO Chair Dummy | 0.02 | 0.02 | 0.02 |
| | (0.23) | (0.23) | (0.23) |
| CEO Ownership Dummy | −0.02 | −0.02 | −0.02 |
| | (0.18) | (0.18) | (0.18) |
| Interlock Dummy | $0.05^{*}$ | $0.05^{*}$ | $0.05^{*}$ |
| | (0.08) | (0.08) | (0.08) |
| Year dummies | yes | yes | yes |
| Industry dummies | yes | yes | yes |
| CEO dummies | yes | yes | yes |
| Adjusted $R^2$ | 70.61% | 70.61% | 70.61% |
| Number of observations | 25845 | 25845 | 25845 |

Note: The table reports regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$. We regress the log of total CEO compensation on stock return, peer group and control variables. Peer performance is aggregated according to the Kernel-based approach. We control for firm size, growth options, CEO tenure, regulation dummy, firm stock return variance, CEO chair dummy, CEO ownership dummy, and interlock dummy. We also include year, industry, and CEO dummies. We report coefficients, adjusted $R^2$, and number of observations. P-values are reported in parenthesis. Significance levels are denoted as follows 1% ($***$), 5% ($**$) and 10% ($*$).

Table 3.6: Regressions estimating the sensitivity of CEO compensation to RPE

| Independent Variables | Knor (scaled) | Kcos (scaled) | Kuni (scaled) |
|---|---|---|---|
| Intercept | $4.05^{***}$ | $4.05^{***}$ | $4.05^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Firm stock return | $0.05^{***}$ | $0.05^{***}$ | $0.05^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Peer return (Knor) | $-0.35^{***}$ | | |
| | (0.00) | | |
| Peer return (Kcos) | | $-0.35^{***}$ | |
| | | (0.00) | |
| Peer return (Kuni) | | | $-0.34^{**}$ |
| | | | (0.01) |
| Firm size (sales) | $0.41^{***}$ | $0.41^{***}$ | $0.41^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Growth options | $0.00^{***}$ | $0.00^{***}$ | $0.00^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| CEO Tenure | $0.12^{***}$ | $0.12^{***}$ | $0.12^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Regulation Dummy | −0.06 | −0.06 | −0.06 |
| | (0.89) | (0.89) | (0.89) |
| Firm Stock Return Variance | $0.62^{***}$ | $0.62^{***}$ | $0.62^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| CEO Chair Dummy | 0.02 | 0.02 | 0.02 |
| | (0.23) | (0.23) | (0.23) |
| CEO Ownership Dummy | −0.02 | −0.02 | −0.02 |
| | (0.18) | (0.18) | (0.18) |
| Interlock Dummy | $0.05^{*}$ | $0.05^{*}$ | $0.05^{*}$ |
| | (0.08) | (0.08) | (0.08) |
| Year dummies | yes | yes | yes |
| Industry dummies | yes | yes | yes |
| CEO dummies | yes | yes | yes |
| Adjusted $R^2$ | 70.61% | 70.61% | 70.61% |
| Number of observations | 25845 | 25845 | 25845 |

Note: The table reports regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$. We regress the log of total CEO compensation on stock return, peer group and control variables. Peer performance is aggregated according to the adjusted Kernel-based approach. We control for firm size, growth options, CEO tenure, regulation dummy, firm stock return variance, CEO chair dummy, CEO ownership dummy, and interlock dummy. We also include year, industry, and CEO dummies. We report coefficients, adjusted $R^2$, and number of observations. P-values are reported in parentheses. Significance levels are denoted as follows 1% ($***$), 5% ($**$) and 10% ($*$).

Table 3.7: Regressions estimating the sensitivity of CEO compensation to RPE

| Independent Variables | Knor (unscaled) | Kcos (unscaled) | Kuni (unscaled) |
|---|---|---|---|
| Intercept | 4.07 *** | 4.07*** | 4.07*** |
| | (0.00) | (0.00) | (0.00) |
| Firm stock return | 0.06*** | 0.06*** | 0.06*** |
| | (0.00) | (0.00) | (0.00) |
| Peer return (Industry) | −0.05** | −0.05** | −0.05** |
| | (0.01) | (0.01) | (0.01) |
| Peer return (Industry/Size) | −0.03 | −0.02 | −0.03 |
| | (0.16) | (0.16) | (0.16) |
| Peer return (Knor) | −0.35** | | |
| | (0.02) | | |
| Peer return (Kcos) | | −0.30** | |
| | | (0.02) | |
| Peer return (Kuni) | | | −0.29** |
| | | | (0.02) |
| Firm size (sales) | 0.41*** | 0.41*** | 0.41*** |
| | (0.00) | (0.00) | (0.00) |
| Growth options | 0.00 *** | 0.00*** | 0.00*** |
| | (0.00) | (0.00) | (0.00) |
| CEO Tenure | 0.12*** | 0.12*** | 0.12*** |
| | (0.00) | (0.00) | (0.00) |
| Regulation Dummy | −0.06 | −0.06 | −0.06 |
| | (0.88) | (0.88) | (0.88) |
| Firm Stock Return Variance | 0.61*** | 0.61*** | 0.61*** |
| | (0.00) | (0.00) | (0.00) |
| CEO Chair Dummy | 0.02 | 0.029 | 0.02 |
| | (0.25) | (0.25) | (0.23) |
| CEO Ownership Dummy | −0.02 | −0.02 | −0.02 |
| | (0.17) | (0.17) | (0.17) |
| Interlock Dummy | 0.05 * | 0.05* | 0.05* |
| | (0.07) | (0.07) | (0.07) |
| Year dummies | yes | yes | yes |
| Industry dummies | yes | yes | yes |
| CEO dummies | yes | yes | yes |
| $R^2$ | 75.95% | 75.95% | 75.95% |
| Number of observations | 25,845 | 25,845 | 25,845 |

Note: The table reports regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$. Here we simultaneously include industry, industry/size peer group and the Kernel-based peer group. The control variables are firm size, growth options, CEO tenure, regulation dummy, firm stock return variance, CEO chair dummy, CEO ownership dummy, and interlock dummy. We also include year, industry, and CEO dummies. We report coefficients, $R^2$ and number of observations. P-values are reported in parentheses. Significance level are denoted as follows 1% ($***$), 5% ($**$) and 10% ($*$).

Table 3.8: Regressions estimating the sensitivity of CEO compensation to RPE

| Independent Variables | Knor (scaled) | Kcos (scaled) | Kuni (scaled) |
|---|---|---|---|
| Intercept | $4.07^{***}$ | $4.07^{***}$ | $4.07^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Firm stock return | $0.06^{***}$ | $0.06^{***}$ | $0.06^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Peer return (Industry) | $-0.05^{**}$ | $-0.05^{**}$ | $-0.05^{**}$ |
| | (0.01) | (0.01) | (0.01) |
| Peer return (Industry/Size) | −0.02 | −0.02 | −0.02 |
| | (0.16) | (0.16) | (0.16) |
| Peer return (Knor) | $-0.31^{**}$ | | |
| | (0.01) | | |
| Peer return (Kcos) | | $-0.31^{**}$ | |
| | | (0.01) | |
| Peer return (Kuni) | | | $-0.31^{**}$ |
| | | | (0.01) |
| Firm size (sales) | $0.41^{***}$ | $0.41^{***}$ | $0.41^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Growth options | $0.00^{***}$ | $0.00^{***}$ | $0.00^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| CEO Tenure | $0.12^{***}$ | $0.12^{***}$ | $0.12^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Regulation Dummy | −0.06 | −0.06 | −0.06 |
| | (0.89) | (0.89) | (0.89) |
| Firm Stock Return Variance | $0.61^{***}$ | $0.61^{***}$ | $0.61^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| CEO Chair Dummy | 0.02 | 0.02 | 0.02 |
| | (0.25) | (0.25) | (0.25) |
| CEO Ownership Dummy | −0.02 | −0.02 | −0.02 |
| | (0.17) | (0.17) | (0.17) |
| Interlock Dummy | $0.05^{*}$ | $0.05^{*}$ | $0.05^{*}$ |
| | (0.07) | (0.07) | (0.07) |
| Year dummies | yes | yes | yes |
| Industry dummies | yes | yes | yes |
| CEO dummies | yes | yes | yes |
| $R^2$ | 75.95% | 75.95% | 75.95% |
| Number of observations | 25845 | 25845 | 25845 |

Note: The table reports regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$. Here we simultaneously include industry, industry/size peer group and the adjusted Kernel-based peer group. The control variables are firm size, growth options, CEO tenure, regulation dummy, firm stock return variance, CEO chair dummy, CEO ownership dummy and interlock dummy. We also include year, industry, and CEO dummies. We report coefficients, $R^2$ and number of observations. P-values are reported in parentheses beneath each coefficient estimate. Significance levels are denoted as follows 1% ($***$), 5% ($**$) and 10% ($*$).

Table 3.9: Strong-form test of RPE

| | | | unscaled | | | scaled | | |
|---|---|---|---|---|---|---|---|---|
| Independent Variables | Industry | industry/size | Knor | Kcos | Kuni | Knor | Kcos | Kuni |
| Intercept | 1.93$^{*}$ | 1.97 | 0.87 | 0.88 | 0.90 | 0.87 | 0.87 | 0.88 |
| | (0.09) | (0.11) | (0.60) | (0.60) | (0.60) | (0.60) | (0.60) | (0.60) |
| Unsystematic Firm Perf | 0.06$^{***}$ | 0.06$^{***}$ | 0.05$^{***}$ | 0.05$^{***}$ | 0.05$^{***}$ | 0.05$^{***}$ | 0.05$^{***}$ | 0.05$^{***}$ |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Systematic Firm Perf | 0.523$^{**}$ | 0.52$^{**}$ | 0.78$^{**}$ | 0.78$^{**}$ | 0.78$^{**}$ | 0.79$^{**}$ | 0.78$^{**}$ | 0.78$^{**}$ |
| | (0.01) | (0.02) | (0.03) | (0.03) | (0.04) | (0.03) | (0.03) | (0.03) |
| Control variables | yes | yes | yes | yes | yes | yes | yes | yes |
| Year dummies | yes | yes | yes | yes | yes | yes | yes | yes |
| Industry dummies | yes | yes | yes | yes | yes | yes | yes | yes |
| CEO dummies | yes | yes | yes | yes | yes | yes | yes | yes |
| $R^2$ | 76.20% | 76.20% | 75.92% | 75.92% | 75.92% | 75.92% | 75.92% | 75.92% |
| Number of observations | 25845 | 25845 | 25845 | 25845 | 25845 | 25845 | 25845 | 25845 |

Note: Table documents regression results for the equation $Comp_{it} = \delta_0 + \delta_1 \cdot UnsysFirmPerformance_{it} + \delta_2 \cdot SystFirmPerformance_{it} + \delta_3 \cdot C_{it} + \epsilon_{it}$. Here we regress the logarithm of CEO compensation on unsystematic firm performance, systematic firm performance, and control variables for 25845 firm-year observations over the time span 1992-2011. We use industry, industry/size as well as Kernel-based methodology to construct systematic variables. For more details on systematic and unsystematic variable construction see Section 3.2.3. We report coefficients, $R^2$, and number of observations. P-values are reported in parentheses. Significance levels are denoted as follows 1% ($***$), 5% ($**$) and 10% ($*$).

Table 3.10: Portfolio Analysis

| Pf | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | L–S |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | fitted CEO Pay | | | | | |
| raw | 0.78 | 0.99 | 1.03 | 0.94 | 1.15 | 1.13 | 0.90 | 1.01 | 1.10 | 1.03 | 0.25 |
| t | 2.11 | 2.71 | 2.69 | 2.81 | 2.92 | 3.23 | 2.59 | 2.97 | 3.74 | 3.00 | 1.00 |
| FF | 0.39 | 0.61 | 0.72 | 0.57 | 0.72 | 0.74 | 0.41 | 0.76 | 0.71 | 0.55 | 0.16 |
| t-FF | 1.55 | 2.26 | 2.08 | 2.59 | 2.31 | 3.38 | 1.63 | 2.83 | 3.41 | 2.52 | 0.63 |
| | | | | | | fitted relatives CEO Pay | | | | | |
| raw | 0.96 | 1.12 | 0.98 | 1.00 | 1.19 | 0.94 | 1.14 | 0.80 | 1.03 | 0.81 | -0.15 |
| t | 3.00 | 3.20 | 3.14 | 3.07 | 3.87 | 2.88 | 3.35 | 2.44 | 2.55 | 2.13 | -0.49 |
| FF | 0.63 | 0.82 | 0.55 | 0.52 | 0.76 | 0.45 | 0.62 | 0.24 | 0.46 | 0.45 | -0.18 |
| t-FF | 3.21 | 2.49 | 2.72 | 2.68 | 3.31 | 2.31 | 2.45 | 1.24 | 1.74 | 1.64 | -0.53 |

Note: This table reports averages of value weighted (VW) stock returns over 1992-2011 sorted into 10 groups by the predicted compensation variable and the deflated predicted compensation variable. In this table, we use a industry/size peer group to construct predicted and deflated predicted compensation variables. We use the methodology described in section 3.3.1 to construct these variables. We report t-statistics (t) below averages. We also report four-factor alphas from regressing the VW return on the Fama-French-Carhart factors (FF) and its t-statistics (t-FF).

Table 3.11: Portfolio Analysis

| Pf | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | L–S |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | fitted CEO Pay | | | | | |
| raw | 0.98 | 0.96 | 1.01 | 0.88 | 0.68 | 1.01 | 0.99 | 0.96 | 0.87 | 0.79 | -0.20 |
| t | 2.67 | 2.59 | 2.89 | 2.24 | 1.84 | 2.85 | 2.85 | 3.11 | 2.94 | 2.63 | -0.75 |
| FF | 0.62 | 0.52 | 0.67 | 0.47 | 0.27 | 0.64 | 0.55 | 0.60 | 0.55 | 0.31 | -0.39 |
| t-FF | 2.94 | 2.06 | 2.49 | 1.60 | 1.07 | 2.48 | 2.57 | 2.59 | 2.72 | 1.84 | -1.27 |
| | | | | | | fitted relatives CEO Pay | | | | | |
| raw | 0.86 | 0.99 | 1.02 | 0.89 | 1.08 | 1.09 | 1.01 | 0.92 | 0.75 | 1.03 | 0.16 |
| t | 2.96 | 3.19 | 3.21 | 2.83 | 3.33 | 3.34 | 3.17 | 2.80 | 2.10 | 2.75 | 0.58 |
| FF | 0.50 | 0.64 | 0.56 | 0.39 | 0.65 | 0.64 | 0.50 | 0.40 | 0.23 | 0.66 | 0.16 |
| t-FF | 3.37 | 3.41 | 2.38 | 2.35 | 2.71 | 2.78 | 2.45 | 2.02 | 0.93 | 2.45 | 0.56 |

Note: This table reports averages of value weighted (VW) stock returns over 1992-2011 sorted into 10 groups by the predicted compensation variable and the deflated predicted compensation variable. In this table, we use normal Kernel-based peer group to construct predicted and deflated predicted compensation variables. We use the methodology described in section 3.3.1 to construct these variables. We report t-statistics (t) below averages. We also four-factor alphas from regressing the VW return on the Fama-French-Carhart factors (FF) and its t-statistics (t-FF).

Table 3.12: Portfolio Analysis

| Pf | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | L–S |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | fitted CEO Pay | | | | | |
| raw | 0.90 | 1.13 | 1.03 | 1.04 | 0.58 | 0.92 | 1.12 | 0.99 | 0.75 | 0.83 | -0.08 |
| t | 2.46 | 3.33 | 2.96 | 2.91 | 1.52 | 2.89 | 3.23 | 3.26 | 2.45 | 2.77 | -0.29 |
| FF | 0.54 | 0.71 | 0.66 | 0.68 | 0.09 | 0.55 | 0.69 | 0.63 | 0.44 | 0.34 | -0.28 |
| t-FF | 2.56 | 3.09 | 2.53 | 2.64 | 0.41 | 2.47 | 3.26 | 2.99 | 1.96 | 2.01 | 0.36 |
| | | | | | | fitted relatives CEO Pay | | | | | |
| raw | 0.86 | 1.01 | 1.01 | 0.88 | 1.09 | 1.05 | 0.99 | 0.95 | 0.78 | 0.96 | 0.10 |
| t | 2.94 | 3.28 | 3.18 | 2.82 | 3.32 | 3.24 | 3.17 | 2.91 | 2.24 | 2.52 | 0.37 |
| FF | 0.49 | 0.66 | 0.56 | 0.38 | 0.65 | 0.59 | 0.49 | 0.43 | 0.24 | 0.59 | 0.10 |
| t-FF | 3.33 | 3.56 | 2.41 | 2.24 | 2.72 | 2.64 | 2.39 | 2.18 | 1.01 | 2.25 | 0.35 |

Note: This table reports averages of value weighted (VW) stock returns over 1992-2011 sorted into 10 groups by the predicted compensation variable and the deflated predicted compensation variable. In this table, we use a cosine Kernel-based peer group to construct predicted and deflated predicted compensation variables. We use the methodology described in section 3.3.1 to construct these variables. We report the t-statistics (t) below averages. We also report four-factor alphas from regressing the VW return on the Fama-French-Carhart factors (FF) and its t-statistics (t-FF).

Table 3.13: Portfolio Analysis

| Pf | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | L–S |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | fitted CEO Pay | | | | | |
| raw | 1.00 | 0.88 | 1.03 | 1.02 | 0.77 | 1.13 | 0.88 | 0.87 | 0.90 | 0.82 | -0.19 |
| t | 2.78 | 2.39 | 2.99 | 2.71 | 1.94 | 3.37 | 2.45 | 2.86 | 2.91 | 2.77 | -0.72 |
| FF | 0.63 | 0.41 | 0.71 | 0.69 | 0.50 | 0.76 | 0.43 | 0.50 | 0.59 | 0.36 | -0.36 |
| t-FF | 2.90 | 1.67 | 2.70 | 2.41 | 1.48 | 3.08 | 2.17 | 2.25 | 2.41 | 2.10 | -1.13 |
| | | | | | | fitted relatives CEO Pay | | | | | |
| raw | 0.86 | 1.06 | 1.02 | 0.88 | 1.07 | 1.11 | 0.98 | 0.91 | 0.78 | 1.02 | 0.16 |
| t | 2.95 | 3.18 | 3.20 | 2.84 | 3.31 | 3.40 | 3.10 | 2.79 | 2.14 | 2.74 | 0.58 |
| FF | 0.50 | 0.76 | 0.57 | 0.39 | 0.63 | 0.66 | 0.48 | 0.39 | 0.25 | 0.65 | 0.15 |
| t-FF | 3.35 | 2.77 | 2.39 | 2.34 | 2.63 | 2.90 | 2.33 | 2.02 | 0.99 | 2.45 | 0.54 |

Note: This table reports averages of value weighted (VW) stock returns over 1992-2011 sorted into 10 groups by the predicted compensation variable and the deflated predicted compensation variable. In this table, we use a uniform Kernel-based peer group to construct predicted and deflated predicted compensation variables. We use the methodology described in section 3.3.1 to construct these variables. We report the t-statistics (t) below averages. We also report four-factor alphas from regressing the VW return on the Fama-French-Carhart factors (FF) and its t-statistics (t-FF).

# Conclusion

This dissertation examines relative performance evaluation hypothesis which suggests that tying an agent's compensation relative to a peer group performance removes exogenous shocks from the agent's compensation. As such it offers a more informative measure of the agent's effort. This is a theoretical prediction established in the agency theory. Executive compensation is particularly suitable for RPE testing due to the fact that the risk-sharing benefits of RPE in executive contracts are more likely to outstrip its costs to the shareholders. Yet the use of RPE has not been limited to this component of the compensation contract only. Many studies examine whether conditions on which the manager is forced or encouraged to leave the firm are based on relative performance evaluation. To that end, relative performance evaluation in executive contracts represents one segment of a firm's corporate governance policy.

This dissertation contributes and complements to the literature on relative performance evaluation, executive compensation and corporate governance. In particular, it enriches the academic literature along several dimensions. Chapter 1 offers a state-of-the-art empirical literature overview on relative performance evaluation. Insights from the empirical literature on RPE that span accounting, organizational, labor and personnel economics, corporate finance and organizational behavior offer an overview of factors that affect inferences drawn on RPE in executive pay and turnover decisions. Inclusion of such factors in empirical tests of RPE have important implication for the power of these tests and should be taken into account in the future research on RPE. Existing evidence on relative performance in the banking industry in the countries outside U.S. is scarce. To that end, Chapter 2 provides evidence regarding the presence of RPE in executive pay and its informative value in the sample of non-U.S., international banks from 2004 to 2013. The findings indicate that the RPE use in executive pay in the sample of non-U.S. banks is not just an empty rhetoric – we find strong evidence of RPE in the subsample of RPE disclosing banks. This evidence is robust across different RPE tests and peer group specifications. In addition, we determine the main drivers of RPE in the banking industry – firm size and growth options. Precisely, the larger banks seem to be more inclined to entertain the use of RPE. On the contrary, the high growth option banks are less likely to do so. Chapter 3 introduces a new method for peer group construction – a Kernel based peer group approach. This method is based on traditional industry-size peer group approach developed by Albuquerque (2009). However, in contract to the Albuquerque's method, the Kernel-based approach allows for individual peer group specification that more closely corresponds to the target firm in terms of firm size. We test RPE use on the large sample of U.S. firms and place the Kernel-based method in juxtaposition to the

traditional industry-size and industry peer groups. The results suggest that our method seems to be better able to filter common risk from the compensation contract than the traditional industry-size specification and therefore provides a more powerful tests of RPE. In addition, we report that on average some noise was removed from the executive pay contracts in our sample of U.S. firms from 1992-2011.

Given that the RPE evidence outside the U.S. is scarce, executive compensation contracts of the non-U.S. large banks in the context of RPE are a subject worth further investigation. A deeper investigation of this subject should offer an understanding on how legal, cultural, and political factors, as well as the internal governance quality affect managerial incentive designs in the financial institutions. Hence, an interesting topic for future research would be considering how the use of RPE is affected by the equity market development of home nations of the non-U.S. banks. It might be that a bank might not rely on the equity returns to filter the systematic component of firm performance if it does not have the confidence in the equity market informativeness. In addition, examining whether the use of relative performance varies with a nation's legal environment is also an intriguing question for future research. Last but not least, the future research could also examine how the quality of the corporate governance system affects the policies on relative performance evaluation.

# Appendices

# Appendix A

## A.1 Regression results

### A.1.1 Kernel–based peers

The details regarding the construction of Kernel-based peers are reported in the section 3.2.2.2 of the Chapter 3.

### A.1.2 Iterative peer group construction

For additional robustness we follow a complementary way of creating peer groups in applying the following iterative algorithm. This iterative approach was introduced by Dikolli et al. (2013) and Black et al. (2015).

In a fist step, we measure the correlation between the performance measures of the target firm $j$ and other firms in the sample over a specific time period, $t = 1, ..., T$ and for $i = 1, ..., N$ comparison firms.[1]

$$Corr(Perf_{jt}, Perf_{it}) \tag{A.1}$$

Second, we start the iterative algorithm by regressing the performance of every firm in the sample on the average performance of all the other firms in the sample (including the target firm), ($Perf_{Average}$):

$$Perf_i = a_i + b_i \cdot Perf_{Average} + e_i \quad \text{where} \quad i = 1, ..., N \quad \text{and} \quad e_i \sim \mathcal{N}(0, \sigma^2) \tag{A.2}$$

The third step consists of checking the statistical significance of the parameter estimate $b$.

In a fourth step, if the parameter estimate turns out to be insignificant, we reduce the sample size to the new value $N_{new}$:

$$N_{new} = (k + 1) \cdot \frac{N}{3 \cdot k} \quad \text{where} \quad k = 1, 2, 3... \tag{A.3}$$

is the index of the $k^{th}$ reduction of the original sample

[1] We throw away firms with less than 25 joint observations with the target firm and firms with a standard deviation of zero, excluding NAs. We replace zero or negative total assets (proxy for firm size) with NAs.

We perform the same regression as before on the reduced sample size:

$$Perf_i = a_i + b_i \cdot Perf_{Average} + e_i \quad \text{where} \quad i = 1, j, ..., N_{new} \quad \text{and} \quad e_i \sim \mathcal{N}(0, \sigma^2) \tag{A.4}$$

In case the parameter estimates are significant we increase our sample by adding one firm $N_{new} = N_{new} + 1$ and repeat the same regression with a new number of firms in our sample, $N_{new}$. We repeat this step until the $b_i$ coefficient is insignificant. Once this condition is achieved, we stop the iteration.

Based on the parameter estimates obtained in this process, following Dikolli et al. (2013) and Black et al. (2015), we construct the performance weight for the firm $i$ in our sample:

$$w_i^\star = \frac{\frac{b_i}{\sigma_i}}{\sum_{i=1}^{N} \frac{b_i}{\sigma_i}} \tag{A.5}$$

Now we aggregate the peer group performance for the firm $i$:[2]

$$Peer\ Perf = \sum_{i=1}^{N} w_i^\star \cdot Perf_i - \sum_{i=1}^{N} w_i^\star \cdot a_i \tag{A.6}$$

### A.1.3 Full sample of banks

Panel A of Table A1 reports the results from regressing the logarithm of total compensation on firm stock return, Kernel-based peers, growth options, and log of sales. The parameter estimates on the Kernel-based peer group are negative and insignificant, which is not consistent with the presence of RPE. The estimates hardly differ across several Kernel specifications. They are -0.26 (p-value = 0.38) for the normal Kernel function, -0.16 (p-value = 0.54) for the cosine Kernel function, and -0.20 (p-value = 0.48) for the uniform Kernel function. In Panel A of Table A1 we have slightly adjusted the Kernel-based approach by multiplying the difference of the firm size by the scaling factor introduced in the Chapter 3. We test the presence of RPE by regressing the log of total CEO compensation on firm stock return, peer performance, growth options, and log of sales. We also include year, country, and industry dummies. The coefficient on the log of firm stock return is again positive and statistically significant at the 1% level for every specification. The negative coefficients on the Kernel-based peer portfolio keep persisting. They are -0.22 (p-value = 0.39) for the normal Kernel function, -0.20 (p-value=0.38) for the cosine Kernel function, and -0.27 (p-value=0.29) for the uniform Kernel function. The adjusted

[2]This peer group method allows for the creation of the Market-Adjusted Performance Indicator (MAPI) developed by FehrAdvice & Partners AG. It is calculated in the following manner: The firm performance of the target company ($Perf_{target\ firm}$) is regressed against the above established iterative peer group performance: $Perf_{target\ firm} = \alpha_{target\ firm} + \beta_{target\ firm} \cdot Peer\ Perf + \epsilon_{target\ firm}$. The estimated coefficients obtained from this regression procedure are used for the MAPI calculation: $MAPI_{target\ firm} = Perf_{target\ firm} - \hat{\beta}_{target\ firm} \cdot Peer\ Perf - \hat{\alpha}_{target\ firm}$.

Kernel-based approach reports smaller p-values. The coefficients remain insignificant, revealing no evidence of RPE in the full sample. Panel A of Table A2 dovetails these results. The panel documents the results from regressing the logarithm of total compensation on firm stock return, iterative peers, growth options, and log of sales. We also include year, country, and industry dummies. The parameter estimate on peer return is again negative and insignificant, lending no support for RPE hypothesis.

[Insert Table A1 about here]

[Insert Table A2 about here]

### A.1.4 Weak tests of RPE (disclosure subsample)

Panels B of Table A1 and Table A2 document the same regression procedure on the subsample of banks that explicitly disclose the use of peers in determining their level of CEO compensation. Panel B of Table A1 reports results when the Kernel-based peers are employed, whereas Panel B of Table A2 documents results based on iterative peer group approach. Under the Kernel-based peer group specification, external shocks are removed from the compensation contract, which is consistent with RPE. The peer coefficients do not differ much across the Kernel specifications. They are -0.99 (p-value = 0.03) for the normal Kernel function, -0.81 (p-value = 0.05) for the "cosine" Kernel function, and -0.88 (p-value = 0.06) for the uniform Kernel function. The coefficient on firm stock performance is positive and statistically significant and range from 0.70 to 0.77. Panel B of Table A1 also reports the regression results with the adjusted Kernel-based peers (columns labeled "scaled"). All the Kernel-based peer coefficients keep a negative and statistically significant sign, soundly rejecting the null hypothesis of no RPE. The coefficient of the normal Kernel peer group is -0.82 (p-value = 0.03), of the cosine Kernel peer group -0.83 (p-value = 0.01), and of the uniform Kernel peer group -0.77 (p-value = 0.04). This evidence is supported by the results presented in Panel B of Table A2. Under the iterative peer group specification, the coefficient on peer return is -0.60 and statistically significant (p-value=0.05).

[Insert Table A1 about here]

### A.1.5 Strong-form tests of RPE (disclosure subsample)

We now use strong-form RPE tests in order to test the RPE hypothesis on the disclosing subsample. We use the Kernel-based method in order to construct a systematic performance variable and run the same regression model. Panel C of Table A1 reports the results. In an additional robustness check, we employ the iterative peer group and report the results in Panel C of Table A2. We document insignificant parameter estimates on systematic firm performance. The coefficient of the normal Kernel peer group is 0.04 (p-value = 0.85), of the cosine Kernel peer group 0.08 (p-value = 0.70), and of the uniform Kernel peer group 0.09 (p-value = 0.65). Our results are robust to different specifications of the weights in the Kernel-based approach, which is reported in Panel C of Table A1.

The parameter estimates of the normal Kernel peer group is 0.07 (p-value = 0.75), of the cosine Kernel peer group 0.01 (p-value = 0.96), and of the uniform Kernel peer group 0.09 (p-value = 0.66). The unsystematic firm performance is significant at the 1% level for every Kernel-based specification. The results do not differ much when the iterative peer group approach is used. We again report insignificant parameter estimate on systematic firm performance. The coefficient is -0.26 (p-value=0.45).

[Insert Table A1 about here]

### A.1.6 The drivers of RPE

In this section we estimate equation (2.5). For this purpose, as in the previous section, we use the alternative peer group definitions based on the kernel and iterative approach. The results are presented in Table A3. The parameter estimates on firm size remain statistically significant and have the same sign. The firm size coefficient of the normal Kernel peer group is 2.68 (p-value = 0.00), of the cosine Kernel peer group 2.70 (p-value = 0.00), for the uniform Kernel peer group 2.69 (p-value = 0.00), and for the iterative peer groups is 2.70 (p-value=0.00). The coefficient for growth options remains negative and in most cases statistically significant, lending further support to our results.They are -19.64 (p-value = 0.09) for the normal Kernel peer group, -19.28 (p-value = 0.10) for the cosine Kernel peer group, for the uniform Kernel peer group -19.74 (p-value = 0.09), and -20.08 for the iterative peer group (p-value=0.08). The results are qualitatively similar when we use the adjusted Kernel-based and iterative approach

[Insert Table A3 about here]

## A.2 Clustered standard errors

Here we consider the same regression procedure (equation (2.1)) for the full sample of 42 banks but include clustered standard errors across industry codes. Table A4 reports the regression results when peers are based on industry and industry/size. The coefficient on industry peer is -0.06 (p-value = 0.87), and the coefficient on industry/size peers is -0.31 (p-value = 0.06). That is to say, we find qualitatively similar results to those presented in Panel A of Table 2.4. In addition, in unreported results we find that the results for the Kernel-based approaches are robust to the inclusion of clustered standard errors.

[Insert Table A4 about here]

## A.3 Banks in our sample

[Insert Table A5 about here]

Table A1: Regressions estimating the sensitivity of CEO compensation to RPE

| | Panel A: Weak Form RPE Tests – Full Sample | | | | | | Panel B: Weak Form RPE Tests – Disclosure Subsample | | | | | | Panel C: Strong Form RPE Tests – Disclosure Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | unscaled | | | scaled | | | unscaled | | | scaled | | | unscaled | | | scaled | | |
| Independent Variables | Knor | Kcos | Kuni | Knor | Kcos | Kuni | Knor | Kcos | Kuni | Knor | Kcos | Kuni | Knor | Kcos | Kuni | Knor | Kcos | Kuni |
| Intercept | 3.27* | 3.28* | 3.26* | 3.36* | 3.37* | 3.43* | -3.21 | -3.21 | -3.22 | -2.82 | -2.91 | -2.63 | -3.27 | -3.26 | -3.28 | -2.86 | -2.94 | -2.67 |
| | (0.08) | (0.08) | (0.08) | (0.07) | (0.07) | (0.07) | (0.34) | (0.34) | (0.35) | (0.40) | (0.38) | (0.44) | (0.33) | (0.34) | (0.34) | (0.40) | (0.38) | (0.43) |
| Firm stock return | 0.52*** | 0.51*** | 0.51*** | 0.53*** | 0.53*** | 0.54*** | 0.73*** | 0.73*** | 0.70*** | 0.74*** | 0.77*** | 0.74*** | | | | | | |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | | | | | | |
| Peer return | -0.26 | -0.16 | -0.20 | -0.22 | -0.20 | -0.27 | -0.99** | -0.81* | -0.88* | -0.82** | -0.83** | -0.77** | | | | | | |
| | (0.38) | (0.54) | (0.48) | (0.39) | (0.38) | (0.29) | (0.03) | (0.05) | (0.06) | (0.03) | (0.01) | (0.04) | | | | | | |
| Unsystematic Firm Perf | | | | | | | | | | | | | 0.73*** | 0.73*** | 0.70*** | 0.74*** | 0.77*** | 0.74*** |
| | | | | | | | | | | | | | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Systematic Firm Perf | | | | | | | | | | | | | 0.04 | 0.08 | 0.09 | 0.07 | 0.01 | 0.09 |
| | | | | | | | | | | | | | (0.85) | (0.70) | (0.65) | (0.75) | (0.96) | (0.66) |
| Control variables | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Year dummies | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Industry dummies | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Country dummies | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Adjusted $R^2$ | 76.39% | 76.35% | 76.36% | 76.39% | 76.39% | 76.44% | 65.20% | 65.00% | 64.81% | 65.16% | 65.63% | 65.63% | 65.20% | 65.00% | 64.81% | 65.16% | 65.63% | 65.11% |
| Number of observations | 318 | 318 | 318 | 318 | 318 | 318 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 | 156 |

Note: The Table shows OLS regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$ (weak-form RPE test). We report the results from regressing log of total CEO compensation on stock return and peer performance aggregated based on the Kernel approach and the adjusted Kernel approach. Panel A reports results for the full sample, and Panel B reports results for the disclosure subsample. In addition, Panel C documents OLS regression results for the equation $Comp_{it} = \delta_0 + \delta_1 \cdot UnsysFirmPerformance_{it} + \delta_2 \cdot SystFirmPerformance_{it} + \delta_3 \cdot C_{it} + \epsilon_{it}$ on the subsample of RPE-disclosing banks (strong-form RPE tests). We regress logarithm of CEO compensation on unsystematic firm performance, systematic firm performance, and control variables for 156 firm-year observations over the time span 2004-2013. For more details on the systematic and unsystematic variable construction see Section 2.2.2. We report three versions of the Kernel based approach: 1) based on the pdf of the Standard Normal Distribution (Knor), 2) based the pdf of the Uniform Distribution (Kuni), and 3) based the pdf of the "Cosine Distribution" (Kcos). The columns denoted with scaled refer to the variants where we multiply the standardized differences with a scaling factor, as described in . Significance levels are two-sided and are denoted as follows: 1% (***), 5% (**) and 10% (*). The corresponding p-values are reported in parentheses below each coefficient estimate.

Table A2: Regressions estimating the sensitivity of CEO compensation to RPE

| | Panel A: Weak-Form RPE Tests – Full Sample | Panel B: Weak-Form RPE Tests – Disclosure Subsample | Panel C: Strong-Form RPE Tests – Disclosure Subsample |
|---|---|---|---|
| Independent Variables | Iterative Peer Group | Iterative Peer Group | Iterative Peer Group |
| Intercept | 3.07$^{*}$ | -3.86 | -4.92 |
| | (0.09) | (0.27) | (0.17) |
| Firm stock return | 0.49$^{***}$ | 0.69$^{***}$ | |
| | (0.00) | (0.00) | |
| Peer return (Iterative) | -0.07 | -0.60$^{*}$ | |
| | (0.68) | (0.05) | |
| Systematic Firm Perf | | | -0.26 |
| | | | (0.45) |
| Unsystematic Firm Perf | | | 0.69$^{***}$ |
| | | | (0.00) |
| Firm size (sales) | 0.37$^{***}$ | 0.69$^{***}$ | 0.69$^{***}$ |
| | (0.00) | (0.00) | (0.00) |
| Growth Options | -0.49 | 0.88 | 0.88 |
| | (0.70) | (0.76) | (0.76) |
| Year dummies | yes | yes | yes |
| Industry dummies | yes | yes | yes |
| Country dummies | yes | yes | yes |
| Adjusted $R^2$ | 76.32% | 64.52% | 64.52% |
| Number of observations | 318 | 156 | 156 |

Note: Panel A and B show OLS regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$. The regression results are based on iterative peer group method. Panel A shows the results for the full sample, and Panel B reports the results for the disclosure subsample. Panel C documents OLS regression results for the equation $Comp_{it} = \delta_0 + \delta_1 \cdot UnsysFirmPerformance_{it} + \delta_2 \cdot SystFirmPerformance_{it} + \delta_3 \cdot C_{it} + \epsilon_{it}$ on the subsample of disclosing banks. We regress logarithm of CEO compensation on the unsystematic firm performance, systematic firm performance, and control variables for 156 firm-year observations over the time span 2004-2013. We use iterative peer group specification in order to construct a systematic performance variable. All regressions include year, industry, and country dummies. For more details on systematic and unsystematic variable construction see Section 2.2.2. Significance levels are two-sided and denoted as follows: 1% ($***$), 5% ($**$) and 10% ($*$). The corresponding p-values are reported in parentheses below each coefficient estimate.

Table A3: Logit regression of RPE use in executive compensation contracts

| | unscaled | | | scaled | | | |
|---|---|---|---|---|---|---|---|
| Independent Variables | Knor | Kcos | Kuni | Knor | Kcos | Kuni | Iterative |
| Intercept | -25.30 | -25.86 | -25.18 | -25.85 | -26.14 | -25.76 | -24.91 |
| | (0.13) | (0.12) | (0.13) | (0.12) | (0.12) | (0.12) | (0.14) |
| Compensation | 0.46 | 0.45 | 0.46 | 0.46 | 0.46 | 0.47 | 0.47 |
| | (0.39) | (0.39) | (0.39) | (0.39) | (0.38) | (0.38) | (0.38) |
| Firm Perf | -0.28 | -0.29 | -0.20 | -0.22 | -0.24 | -0.20 | -0.12 |
| | (0.74) | (0.75) | (0.82) | (0.80) | (0.79) | (0.82) | (0.89) |
| Peer return | 1.18 | 0.95 | 0.86 | 0.76 | 0.72 | 0.63 | 0.36 |
| | (0.53) | (0.55) | (0.63) | (0.62) | (0.61) | (0.65) | (0.77) |
| Firm size (sales) | 2.68*** | 2.70*** | 2.69*** | 2.69*** | 2.70*** | 2.71*** | 2.70*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Growth options | -19.64* | -19.28 | -19.74* | -10.26 | -19.09* | -19.42 | -20.08* |
| | (0.09) | (0.10) | (0.09) | (0.10) | (0.09) | (0.10) | (0.09) |
| Year dummies | yes | yes | yes | yes | yes | yes | yes |
| Industry dummies | yes | yes | yes | yes | yes | yes | yes |
| Country dummies | yes | yes | yes | yes | yes | yes | yes |
| $R^2$ | 51.80% | 51.80% | 51.78% | 51.79% | 51.79% | 51.79% | 51.75% |
| Number of observation | 318 | 318 | 318 | 318 | 318 | 318 | 318 |

Note: The table documents logit regression results for the equation $y_{it} = \gamma_0 + \gamma_1 \cdot Comp_{it} + \gamma_2 \cdot FirmPerf_{it} + \gamma_3 \cdot PeerPerf_{it} + \gamma_4 \cdot C_{it} + \epsilon_{it}$. The dependent variable is *RPE*, an indicator variable which is equal to 1 if the firm discloses peer group use in the compensation contracts. We regress *RPE* on firm performance, peer returns, firm size, and growth options for 318 firm-year observations over the time span 2004-2013. We include year, country and industry dummies. We report three versions of the Kernel based approached: 1) based on the pdf of the Standard Normal Distribution (Knor), 2) based the pdf of the Uniform Distribution (Kuni), and 3) based the pdf of the "Cosine Distribution" (Kcos). The panel "scaled" refers to the variants where we multiply the standardized differences with a scaling factor. The last column reports results based on the iterative peer group specification. We report the Cox and Snell's $R^2$. Significance levels are two-sided and are denoted as follows: 1% ($***$), 5% ($**$) and 10% ($*$). The corresponding p-values are reported in parentheses below each coefficient estimate.

Table A4: Regressions estimating the sensitivity of CEO compensation to RPE

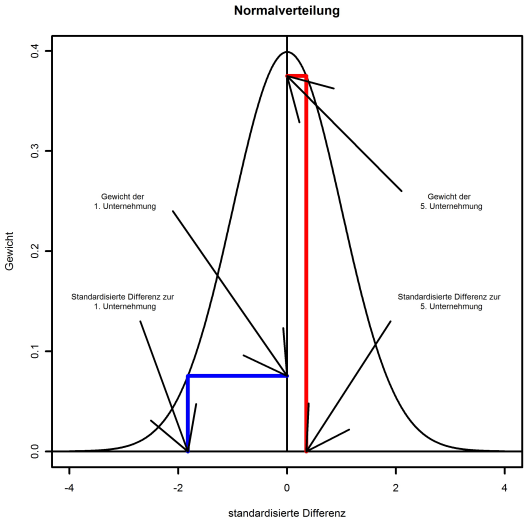
| Independent Variables | Industry Peer Group | Industry/Size Peer Group |
|---|---|---|
| Intercept | $3.18^{**}$ | $3.22^{***}$ |
| | (0.05) | (0.05) |
| Firm stock return | $0.47^{***}$ | $0.56^{***}$ |
| | (0.00) | (0.00) |
| Peer return (Industry) | -0.06 | |
| | (0.87) | |
| Peer return (Industry/Size) | | $-0.31^{*}$ |
| | | (0.06) |
| Firm size (sales) | $0.37^{***}$ | $0.37^{***}$ |
| | (0.00) | (0.00) |
| Growth options | -0.59 | -0.61 |
| | (0.60) | (0.60) |
| Year dummies | yes | yes |
| Industry dummies | yes | yes |
| Country dummies | yes | yes |
| Adjusted $R^2$ | 78.48% | 78.67% |
| Number of observations | 318 | 318 |
| Number of clusters | 5 | 5 |

Note: The table shows OLS regression results for the equation $Comp_{it} = \alpha_0 + \alpha_1 \cdot FirmPerf_{it} + \alpha_2 \cdot PeerPerf_{it} + \alpha_3 \cdot C_{it} + \epsilon_{it}$. The first column presents the results from regressing log of total CEO compensation on stock return, industry peer performance, and other variables. The second column documents regression results based on industry and size quartiles, that is, Albuquerque (2009)'s approach. OLS estimation is based on clustered standard errors. Firm size and growth options for the period 2004 to 2013 are also reported. We include year, industry, and country dummies. The corresponding p-values are reported in parentheses below each coefficient estimate. We report significance levels for 1% ($***$), 5% ($**$) and 10% ($*$).

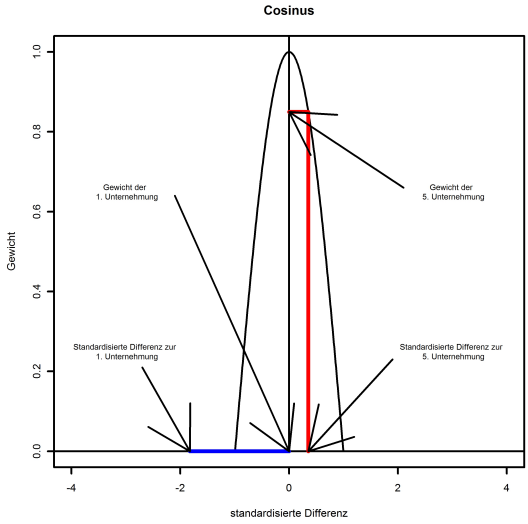
Table A5: List of international banks in the sample

| Name of the Bank | Country |
|---|---|
| SWEDBANK | Sweden |
| CREDIT AGRICOLE | France |
| CHINA MINSHENG BANKING | China |
| BANCO DE SABADELL | Spain |
| HUAXIA BANK | China |
| DNB | Norway |
| BNP PARIBAS | France |
| COMMONWEALTH BANK OF AUSTRALIA | Australia |
| CHINA CONSTRUCTION BANK | China |
| BANK OF CHINA | China |
| CIMB GROUP HOLDINGS | Malaysia |
| HSBC HOLDINGS | UK |
| NORDEA BANK | Sweden |
| BANCO SANTANDER | Spain |
| SEB | Sweden |
| SOCIETE GENERALE | France |
| MALAYAN BANKING | Malaysia |
| PUBLIC BANK | Malaysia |
| FIRSTRAND | South Africa |
| LLOYDS BANKING GROUP | UK |
| BARCLAY | UK |
| ROYAL BANK OF SCOTLAND GROUP | UK |
| NATIONAL AUSTRALIA BANK | Australia |
| CANADIAN IMPERIAL BANK COMMERCE | Canada |
| COMMERZBANK | Germany |
| BANK OF MONTREAL | Canada |
| BANK OF NOVA SCOTIA | Canada |
| DEUTSCHE BANK | Germany |
| WESTPAC BANKING | Australia |
| TORONTO-DOMINION BANK | Canada |
| ROYAL BANK OF CANADA | Canada |
| OVERSEA-CHINESE BANKING | Singapore |
| BANCO POPULAR ESPANOL | Spain |
| UNITED OVERSEAS BANK | Singapore |
| DBS GROUP HOLDINGS | Singapore |
| UBS | Switzerland |
| CREDIT SUISSE GROUP N | Switzerland |
| AUSTRALIA AND NEW ZEALAND BANKING GROUP | Australia |
| STANDARD BANK GROUP | South Africa |
| BANK OF EAST ASIA | Hong Kong |
| NATIONAL BANK OF CANADA | Canada |
| SVENSKA HANDELSBANKEN | Sweden |

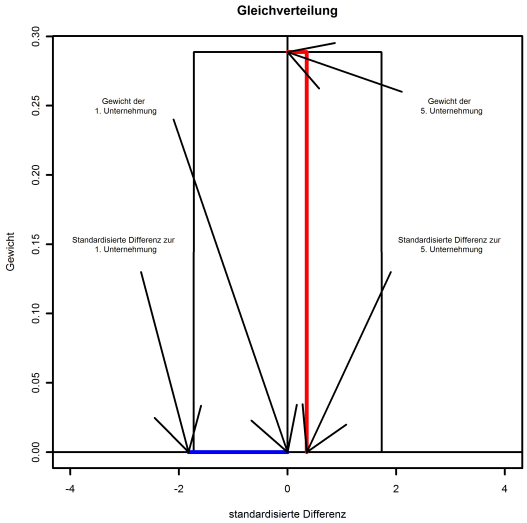
# Appendix B




(a) The Standard Normal Distribution




(b) The "Cosine Distribution"




(c) The Uniform Distribution

Figure B.1: The three types of kernel functions

# Bibliography


Abowd, J. M. and Kaplan, D. S.: 1999, Executive compensation: Six questions that need answering, *The Journal of Economic Perspectives* **13**(4), 145–168.

Adams, R. B. and Mehran, H.: 2003, Is corporate governance different for bank holding companies?, *FRBNY Economic Policy Review* **9**(1), 123–142.

Aebi, V., Sabato, G. and Schmid, M.: 2012, Risk management, corporate governance, and bank performance in the financial crisis, *Journal of Banking and Finance* **36**(12), 3213–3226.

Aggarwal, R. K. and Samwick, A. A.: 1999a, Executive compensation, strategic competition, and relative performance evaluation: Theory and evidence, *Journal of Finance* **54**(6), 1999–2043.

Aggarwal, R. K. and Samwick, A. A.: 1999b, The other side of the trade-off: The impact of risk on executive compensation, *Journal of Political Economy* **107**(1), 65–105.

Alanis, E.: 2015, A new benchmark: Relative performance evaluation with total returns. Working Paper.

Albuquerque, A.: 2009, Peer firms in relative performance evaluation, *Journal of Accounting and Economics* **48**(1), 69–89.

Albuquerque, A. M.: 2014, Do growth-option firms use less relative performance evaluation?, *The Accounting Review* **89**(1), 27–60.

Amba, S. M.: 2014, Corporate governance and firms' financial performance, *Journal of Academic and Business Ethics* **8**, 1–11.

Angelis, D. D. and Grinstein, Y.: 2016, Relative performance evaluation in CEO compensation: A non-agency explanation, *Social Science Research Network* .

Antle, R. and Smith, A.: 1986, An empirical investigation of the relative performance evaluation of corporate executives, *Journal of Accounting Research* **24**(1), 1–39.

Bannister, J. W. and Newman, H. A.: 2003, Analysis of corporate disclosures on relative performance evaluation, *Accounting Horizons* **17**(3), 235–246.

Barakova, I. and Palvia, A.: 2010, Limits to relative performance evaluation: Evidence from bank executive turnover, *Journal of Financial Economic Policy* **2**(3), 214 – 236.

Barro, J. R. and Barro, R. J.: 1990, Pay, performance, and turnover of bank CEOs, *Journal of Labor Economics* **8**(4), 448–481.

Bebchuk, L. A. and Fried, J. M.: 2003, Executive compensation as an agency problem, *Journal of Economic Perspectives* **17**(3), 71–92.

Bebchuk, Lucian, A., Cohen, A. and Spamann, H.: 2010, The wages of failure: Executive compensation at Bear Stearns and Lehman 2000-2008, *ECGI - Finance Working Paper* .

Bebchuk, Lucian, A. and Fried, Jesse, M.: 2004, *Pay Without Performance: The Unfulfilled Promise of Executive Compensation*, Harvard University Press.

Bell, B. and Van Reenen, J.: 2016, CEO pay and the rise of relative performance contracts: A question of governance, *CEP Discussion Paper* (1493).

Berger, A. N. and Smith, D. A.: 2003, Global integration in the banking industry, *Federal Reserve Bulletin* **89**(451).

Berle, A. and Means, G.: 1932, *The modern corporation and private property*, New York, Macmillan Publishing Co.

Bertrand, M. and Mullainathan, S.: 2000, Agents with and without principals, *The American Economic Review* **90**(2), 203–208.

Bertrand, M. and Mullainathan, S.: 2001, Are CEO rewarded for luck? The ones without principals are, *The Quarterly Journal of Economics* **116**(3), 901–932.

Bikker, J. A. and Haaf, K.: 2002, Competition, concentration and their relationship: An empirical analysis of the banking industry, *Journal of Banking and Finance* **26**(11), 2191–2214.

Black, D., Dikolli, S. and Hofmann, C.: 2015, Peer group composition, peer performance aggregation, and detecting relative performance evaluation, *AAA 2012 Management Accounting Section (MAS) Meeting Paper* .

Blackwell, D. W., Brickley, J. A. and Weisback, M. S.: 1994, Accounting information and internal performance evaluation, *Journal of Accounting and Economics* **17**(3), 331 – 358.

Brown, L. D. and Caylor, M. L.: 2004, Corporate governance and firm performance, *Social Sciences Research Network* .

Cai, G. and Zheng, G.: 2016, Executive compensation in business groups: Evidence from China, *China Journal of Accounting Research* **9**(1), 25 – 39.

Carhart, M. M.: 1997, On persistence in mutual funds performance, *The Journal of Finance* **52**(1), 57–82.

Carter, M. E., Ittner, M. C. D. and Zechman, S. L.: 2009, Explicit relative performance evaluation in performance-vested equity grants, *Review of Accounting Studies* **14**(2-3), 269–306.

Celentani, M. and Loveira, R.: 2006, A simple explanation of the relative performance evaluation puzzle, *Review of Economic Dynamics* **9**(3), 525–540.

Chen, C. R., Steiner, T. L. and Whyte, A. M.: 2006, Does stock option-based executive compensation induce risk-taking? An analysis of the banking industry, *Journal of Banking and Finance* **30**(3), 915–945.

Chen, D., Liang, S. and Zhu, P.: 2012, Relative performance evaluation and executive compensation: Evidence from Chinese listed companies, *China Journal of Accounting Research* **5**(2), 127 – 144.

Chen, Y., Li, H. and Zhou, L.-A.: 2005, Relative performance evaluation and the turnover of provincial leaders in China, *Economics Letters* **88**(3), 421 – 425.

Cheng, S. and Xu, X.: 2006, The role of peer performance in managerial compensation surrounding the 1996 telecommunications, *Journal of Accounting and Public Policy* **25**, 596–608.

Cichello, M. S., Fee, C. E., Hadlock, C. J. and Sonti, R.: 2009, Promotions, turnover, and performance evaluation: Evidence from the careers of division managers, *The Accounting Review* **84**(4), 1119–1143.

Cordeiro, J. J., Yang, R., Kent Jr, D. D. and Callahan III, C.: 2014, What determines the variation in relative performance evaluation usage across US industries?, *Management Research Review* **37**(5), 502–514.

Core, J. E., Holthausen, R. W. and Larcker, D. F.: 1999, Corporate governance, chief executive officer compensation, and firm performance, *Journal of Financial Economics* **51**(3), 371–406.

Core, J. and Guay, W.: 1999, The use of equity grants to manage optimal incentive levels, *Journal of Accounting and Economics* **28**(2), 151–184.

Core, J. and Guay, W.: 2002, The other side of the trade-off: The impact of risk on executive compensation: A comment, *Journal of Political Economy* .

Crawford, A. J.: 1999, Relative performance evaluation in CEO pay contracts: Evidence from the commercial banking industry, *Managerial Finance* **25**(9), 34–54.

Crawford, A. J., Ezzell, J. R. and Miles, J. A.: 1995, Bank CEO pay-performance relations and the effects of deregulation, *The Journal of Business* **68**(2), 231–256.

Cuñat, V. and Guadalupe, M.: 2009, Executive compensation and competition in the banking and financial sectors, *Journal of Banking and Finance* **33**(3), 495–504.

De Angelis, D. and Grinstein, Y.: 2011, Relative performance evaluation in CEO compensation: Evidence from the 2006 disclosure rules, *Johnson School Research Paper Series* (39–2010).

Demsetz, R. S. and Strahan, P. E.: 1997, Diversification, size, and risk at bank holding companies, *Journal of Money, Credit and Banking* **29**(3), 300–313.

Diamond, D. W. and Dybvig, P. H.: 1983, Bank runs, deposit insurance, and liquidity, *Journal of Political Economy* **91**(3), 401–419.

Dikolli, S. S., Hofmann, C. and Pfeiffer, T.: 2013, Relative performance evaluation and peer-performance summarization errors, *Review of Accounting Studies* **18**(1), 34–65.

Fama, E. F.: 1980, Agency problems and the theory of the firm, *The Journal of Political Economy* **88**(2), 288–307.

Fama, E. F. and French, K. R.: 1992, The cross-section of expected stock returns, *The Journal of Finance* **47**(2), 427–465.

Fama, E. F. and French, K. R.: 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* **33**, 3–56.

Farmera, M. A., Alexandroua, G. and Archbolda, S.: 2011, New evidence of relative performance evaluation (RPE) in UK chief executive realised incentive compensation, *The 2nd Annual Faculty of Business and Law Conference: Emerging Issues in Business and Law* .

Faulkender, M. and Yang, J.: 2013, Is disclosure an effective cleansing mechanism? The dynamics of compensation peer benchmarking, *Review of Financial Studies* **26**(3), 806–839.

Fee, C. E., Hadlock, C. J., Huang, J. and Pierce, J. R.: 2015, Robust Models of CEO Turnover: New Evidence on Relative Performance Evaluation, *SSRN Scholarly Paper ID 2616738*, Social Science Research Network, Rochester, NY.

Ferrarini, G. and Moloney, N.: 2005, Executive Remuneration in the EU: The Context for Reform, *Oxford Review of Economic Policy* **21**(2), 304–323.

Garen, J. E.: 1994, Executive compensation and principal-agent theory, *Jorunal of Political Economy* **102**(6), 1175–1199.

Garvey, G. and Milbourn, T.: 2003, Incentive compensation when executives can hedge the market: Evidence of relative performance evaluation in the cross section, *Journal of Finance* **58**(4), 1557–1582.

Garvey, G. T. and Milbourn, T. T.: 2006, Asymmetric benchmarking in compensation: Executives are rewarded for good luck but not penalized for bad, *Journal of Financial Economics* **82**(1), 197–225.

Gibbons, R. and Murphy, K. J.: 1990, Relative performance evaluation for chief executive officers, *Industrial and Labor Relations Review* **43**(3), 30–51.

Gibbons, R. and Roberts, J.: 2013, Economic theories of incentives in organizations, *in* R. Gibbons and J. Roberts (eds), *The Handbook of Organizational Economics*, Princeton University Press, chapter 2, pp. 56–100.

Gjesdal, F.: 1982, Information and incentives: The agency information problem, *The Review of Economic Studies* **49**(3), 373–390.

Gompers, P., Ishii, J. and Metrick, A.: 2003, Corporate governance and equity prices, *The Quarterly Journal of Economics* **118**(1), 107–156.

Gong, G., Li, L. Y. and Shin, J. Y.: 2011, Relative performance evaluation and related peer groups in executive compensation contracts, *The Accounting Review* **86**(3), 1007–1043.

Gopalan, R., Milbourn, T. and Song, F.: 2010, Strategic flexibility and the optimality of pay for sector performance, *The Review of Financial Studies* **23**(5), 2060–2098.

Hall, B. J. and Liebman, J. B.: 1998, Are CEOs really paid like bureaucrats?, *The Quarterly Journal of Economics* **113**(3), 653–691.

Hart, O.: 1995, Corporate governance: Some theory and implications, *The Economic Journal* **105**(430), 678–689.

Hermalin, B. E.: 2013, Corporate Goverance, *in* R. Gibbons and J. Roberts (eds), *The Handbook of Organizational Economics*, Princeton University Press, chapter 18, pp. 732–764.

Hoberg, G. and Phillips, G. M.: 2015, Text-based network industries and endogenous product differentiation, *Journal of Political Economy, Forthcoming* .

Hodgson, P.: 2004, The wall street example: Bringing excessive executive compensation into line, Ivey Business Journal.

Holmstrom, B.: 1979, Moral hazard and observability, *The Bell Journal of Economics* **10**(1), 74–91.

Holmstrom, B.: 1982, Moral hazard in teams, *The Bell Journal of Economics* **13**(2), 324–340.

Holmstrom, B.: 1999, Managerial incentive problems: A dynamic perspective, *Working Paper 6875*, National Bureau of Economic Research.

Holmstrom, B. and Milgrom, P.: 1987, Aggregation and linearity in the provision of intertemporal incentives, *Econometrica* **55**(2), 303–28.

Houston, J. F. and James, C.: 1995, CEO compensation and bank risk: Is compensation in banking structured to promote risk taking?, *Journal of Monetary Economics* **36**(2), 405 – 431.

Hubbard, R. G. and Palia, D.: 1995, Executive pay and performance evidence from the U.S. banking industry, *Journal of Financial Economics* **39**(1), 105–130.

Ince, O. S. and Porter, R. B.: 2006, Individual Equity Return Data from Thomson Datastream: Handle with Care!, *Journal of Financial Research* **29**(4), 463–479.

Jaiswal, S. K. and Bhattacharyya, A. K.: 2016, The role of operating efficiency and asset productivity in relative performance evaluation and CEO compensation in indian firms, *DECISION* **43**(21), 201–221.

Janakiraman, S. N.: 2004, Choice of relative performance evaluation for strategic reasons, *Managerial Finance* **30**(6), 66–92.

Janakiraman, S. N., Lambert, R. A. and Larcker, D. F.: 1992, An empirical investigation of the relative performance evaluation hypothesis, *Journal of Accounting Research* **30**(1), 53–69.

Jayaraman, S., Milbourn, T. and Seo, H.: 2015, Product market peers and relative performance evaluation, *Simon Business School Working Paper* (15–25).

Jensen, M. C. and Meckling, W. H.: 1976, Theory of the firm: Managerial behavior, agency costs and ownership structure, *Journal of Financial Economics* **3**(4), 305–360.

Jensen, M. C. and Murphy, K. J.: 1990, Performance pay and top-management incentives, *Journal of Political Economy* **98**(2), 225–264.

Jenter, D. and Kanaan, F.: 2015, CEO turnover and relative peformance evaluation, *The Journal of Finance* **70**(5), 2155–2184.

Joh, S. W.: 1999, Strategic managerial incentive compensation in Japan: Relative performance evaluation and product market collusion, *The Review of Economics and Statistics* **81**(2), 303–313.

John, K. and Qian, Y.: 2003, Incentive features in CEO compensation in the banking indsutry, *FRBNY Economic Policy Review* **9**(1), 109–121.

John, K. and Senbet, L. W.: 1998, Corporate governance and board effectiveness, *Journal of Banking & Finance* **22**(4), 371–403.

Keune, T.: 2015, An empirical examination of ceo relative performance evaluation incentives and R&D, *Social Science Research Network* .

Kren, L.: 2002, Common uncertainty effects on the use of relative performance evaluation for corporate chief executives, *Advances in Accounting* **19**, 119–138.

Lazear, E. and Rosen, S.: 1981, Rank-order tournaments as optimum labor contracts, *The Jorunal of Political Economy* **89**(5), 841–864.

Lazonick, W. and O'Sullivan, M.: 2000, Maximizing shareholder value: A new ideology for corporate governance, *Economy and Society* **29**(1), 13–35.

Lewellen, S.: 2015, Executive compensation and industry peer groups, *London Business School Working Paper* .

Liu, L. S.: 2008, The impact of research and development on relative performance evaluation in the UK, *International Journal of Managerial Finance* **4**(4), 278 – 294.

Liua, L. S. and Starkb, A. W.: 2009, Relative performance evaluation in board cash compensation: UK empirical evidence, *The British Accounting Review* **41**(1), 21–30.

Macey, J. R. and O'Hara, M.: 2003, The corporate governance of banks, *FRBNY Economic Policy Review* **9**(1), 91–107.

Mahoney, P. G.: 1995, Mandatory disclosure as a solution to agency problems, *The University of Chicago Law Review* **62**(3), 1047–1112.

Matsumura, E. M. and Shin, J. Y.: 2006, An Empirical Analysis of an Incentive Plan with Relative Performance Measures: Evidence from a Postal Service, *The Accounting Review* **81**(3), 533–566.

Merton, R. C.: 1974, On the pricing of corporate debt: The risk structure of interest rates, *Journal of Finance* **29**(2), 449–70.

Migrom, P. and Roberts, J.: 1992, *Economics, Organization and Management*, Prentice-Hall.

Morck, R., Shleifer, A. and Vishy, R. W.: 1989, Alternative mechnism for corporate control, *American Economic Review* **79**, 842–852.

Murphy, K.: 2001, Performance standards in incentive contracts, *Journal of Accounting and Economics* **30**(6), 245–278.

Murphy, K. J.: 1999, Executive compensation, *in* O. Ashenfelter and D. Card (eds), *Handbook of Labor Economics*, Vol. 3, Part B, Elsevier, chapter 38, pp. 2485–2563.

Murphy, K. J.: 2013, Executive Compensation: Where We Are, and How We Got There, *in* G. M. Constantinides, M. Harris and R. M. Stulz (eds), *Handbook of the Economics of Finance*, Vol. 2, Part A, Elsevier, chapter 4, pp. 211–356.

Oyer, P.: 2004, Why do firms use incentives that habe no incentive effect?, *Journal of Finance* **59**(4), 1619–1649.

Ozkan, N., Singer, Z. and You, H.: 2012, Mandatory IFRS adoption and the contractual usefulness of accounting information in executive compensation, *Journal of Accounting Research* **50**(4), 1077–1107.

Parrino, R.: 1997, CEO turnover and outside succession A cross-sectional analysis, *Journal of Financial Economics* **46**(2), 165–197.

Prendergast, C.: 1999, The provision of incentives in firms, *Journal of Economic Literature* **37**(1), 7–63.

Rajgopal, S., Shevlin, T. J. and Zamora, V. L.: 2006, CEOs' outside employment opportunities and the lack of relative performance evaluation in compensation contracts, *The Journal of Finance* **61**(4), 1813–1844.

Ross, S. A.: 1973, The Economic Theory of Agency: The Principal's Problem, *The American Economic Review* **63**(2), 134–139.

Salanie, B.: 2005, *The economics of contracts: a primer*, MIT press.

Saunders, A., Strock, E. and Travlos, N. G.: 1990, Ownership structure, deregulation, and bank risk taking, *The Journal of Finance* **45**(2), 643–654.

Shavell, S.: 1979, Risk Sharing and Incentives in the Principal and Agent Relationship, *The Bell Journal of Economics* **10**(1), 55–73.

Shleifer, A. and Vishny, R. W.: 1997, A survey of corporate governance, *The Journal of Finance* **52**(2), 737–783.

Smith, A.: 1776, *An Inquiry into the Nature and Causes of the Wealth of Nations*.

Smith, C. W. and Watts, R. L.: 1992, The investment opportunity set and corporate financing, dividend, and compensation policies, *Journal of Financial Economics* **32**(3), 263–292.

Sun, W., Stewart, J. and Pollard, D.: 2011, Introduction: Rethinking corporate governance – Lessons from the global financial crisis, *in* W. Sun, J. Stewart and D. Pollard (eds), *Corporate Governance and the Global Financial Crisis: International Perspectives*, Cambridge University Press, chapter 1, pp. 1–28.

Tice, F. M.: 2015, The effect of relative performance evaluation on investment efficiency and firm performance, *Social Science Research Newtwork* .

Tirole, J.: 2001, Corporate governance, *Econometrica* **69**(1), 1–35.

Tosi, H., Aldag, R. and Storey, R.: 1973, On the measurement of the environment: An assessment of the lawrence and lorsch environmental uncertainty subscale, *Administrative Science Quarterly* **18**(27–36).

Tung, F.: 2011, Pay for bank performance: Structuring executive compensation for risk regulation, *Northwestern University Law Review* **105**(3), 1205–1252.

Warner, J. B., Ross, L. W. and Wurck, K. H.: 1988, Stock prices and top management changes, *Journal of Financial Economics* **20**, 461–492.

Weisbach, M. S.: 1988, Outside directors and CEO turnover, *Jorunal of Financial Economics* .

Wu, J. S. and Zhang, I.: 2010, Accounting integration and comparability: Evidence from relative performance evaluation around IFRS adoption, *Simon School Working Paper* (10–25).

Wu, M.-C., Lin, H.-C. L., I-Cheng and Chun-Feng, L.: 2009, The effects of corporate governance on firm performance, *Working Paper National Changua University of Education* .